DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

EDITED BY EDWARD LIVEING, B.A.
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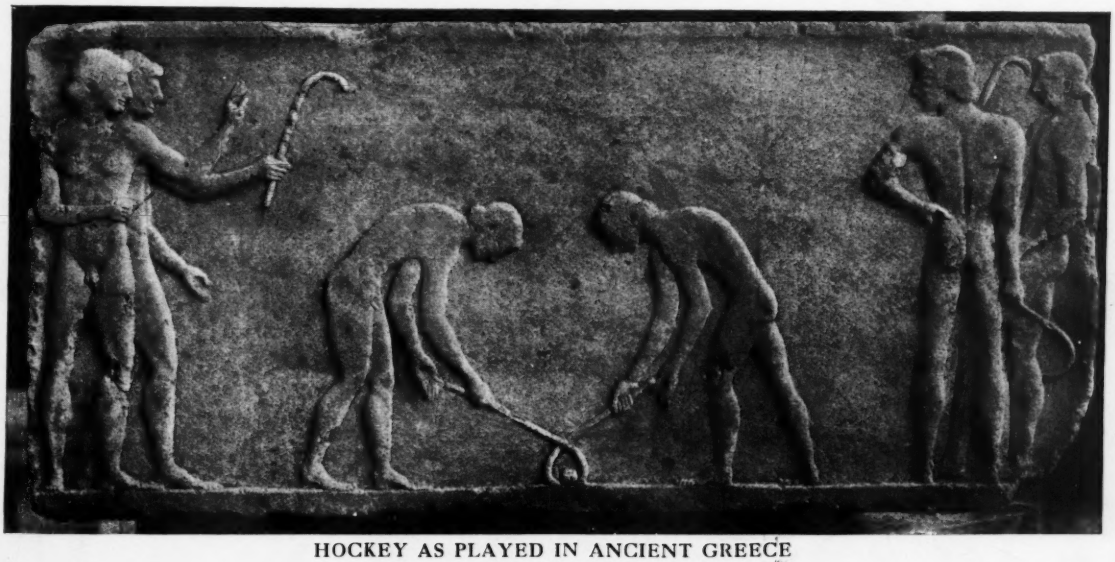

HOCKEY AS PLAYED IN ANCIENT GREECE
A remarkable new discovery described in this number

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JOHN MURRAY, 50A ALBEMARLE STREET, LONDON, W.1.

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DISCOVERY. A Monthly Popular Journal of Knowledge.

Edited by EDWARD LIVEING, B.A., Rothersthorpe, Northampton, to whom all Editorial Communications should be addressed. (Dr. A. S. RUSSELL continues to act as Scientific Adviser.)

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Editorial Notes

THE response to the appeal in our January number for criticisms and suggestions has been most gratifying. A large number of correspondents, from many parts of the English-speaking world, have established our opinion that DISCOVERY fulfils a very definite purpose, and have supplied us with many helpful suggestions. It was not to be anticipated that there should have been complete unanimity of opinion as to the most desirable subjects for treatment in a journal of this nature. It is certain that an individual who could take equal interest in all the articles of any one number of DISCOVERY would be exceptional. But that is a matter for pride rather than regret; our correspondence has shown that one section of our readers finds most acceptable what another finds rather outside his sphere of interest. We aim at putting the individual in the widest possible relationship with the world of to-day and the world of yesterday—and, if possible, with the world of to-morrow. And we believe that the space we allot to the ancient civilisations of Egypt, Greece, and Rome is helpful in directing our attention at times away from this age of great scientific progress, to the days when man was less learned, maybe, and less incessantly busied, but none the less human and often more sublime.

* * * * *

A suggestion which occurred to several of our readers was that more space might be allotted to Astronomy. Arrangements are being made to comply with this request. Again, several correspondents find philosophy a fascinating subject, and would like to solve the problem of personality, of consciousness, and the real existence of things we appreciate by our five senses. One correspondent shyly suggests mathematics as a subject for an article. Of course, mathematics presents a very special problem. It has been said—rather unfairly—that the scientist is the only man who has anything to say to-day, and the only man who does not know how to say it. It is true that the great difficulty in following the lines along which scientific thought of the moment is travelling arises from the fact that scientists have had to evolve a kind of shorthand of their own in order to refer briefly to ideas which among scientists are familiar. The mathematician has carried this process to extremes, and talks a language which is beautifully concise, but hardly lends itself to the literary method. We should be glad, however, to consider an article which would explain the mysteries of mathematics to those of us who never succeeded in travelling beyond quadratic equations.

* * * * *

Many other useful suggestions are being considered, and, if possible, arrangements will be made to provide articles dealing with subjects in Biology, History, and Physics to which readers have referred. We trust that all—including a vivacious but anonymous lady correspondent from Arizona, and a friend who writes, as a working blacksmith, to offer a useful criticism—will continue to advise and criticise us with the kindness they have manifested in the present correspondence.

* * * * *

There are two extreme points of view with regard to the relationship between science and industry. The first was that of the successful steel magnate, who brought his son to a university with directions that he should be taught steel, and steel only. The second inspired an enthusiastic mathematician, at the close of a dinner held by a learned society, to call for the toast "Here's to pure mathematics—may it never be any use to anybody." It is, in fact, impossible to divorce the search for scientific truth from the tireless

effort to exploit the world's resources, and link together the four corners of the world in the great web of modern industry. There is no fact, however insignificant it appears, which may not come to have a bearing on the daily life of mankind. In a sense, the doctor, the scientist, the lawyer, the politician, and the journalist all work for one object—the safety and development of industry. The naturalist who, with butterfly net and specimen box, has often been pointed at with derision as a type of the futility of purely scientific energy, has been the means of making possible the cutting of the Panama Canal by destroying the insect pests that spread disease and death. We would even venture to say that, if great discoveries are to be made, they must come from the investigation of seemingly " useless " phenomena. When the value of a scientific discovery is established for industrial purposes, it may be developed to a very high degree of efficiency, but its limitations can be imagined from the beginning. It is of the essence of the completely new discovery that it was inconceivable before discovery, and how can such knowledge come save by constant disinterested efforts along ways never ventured on before? How many invaluable marvels, from the X-ray to Radium, have come to light as accidents of the laboratory?

* * * * *

The words of Sir Alfred Yarrow, in making his recent gift of £100,000 for the furtherance of scientific research, deserve to be quoted in full: " I should like to record my firm conviction that a patriotic citizen cannot give money, or leave it at his death, to better advantage than towards the development of science, upon which the industrial success of the country so largely depends." It is a matter for special satisfaction that this splendid gift has been earmarked rather for the support of scientific investigators than for building homes of research. In spite of the work of the Medical Research Council, and the grants by the Royal Society towards research in general, this country remains a long way behind America, and even Germany, in its provision for scientific workers. There are, fortunately, if not enough, at any rate a satisfactory number of institutions for scientific study. But the scientist is more important than his house; a scientist could, conceivably, work in the open, whereas even the largest laboratory is comparatively valueless without an inhabitant. And undoubtedly many of those best fitted for the task of new discovery cannot undertake it from financial reasons, while those who do must spend a large proportion of their time, not in original work, but in the exposition of the elements of their lore to students. We hope that these and many other problems at present confronting scientists and their work will be satisfactorily resolved during this decade.

Plants as Travellers

By A. C. Seward, Sc.D., F.R.S.

Master of Downing College and Professor of Botany in the University of Cambridge

THE publication of a paper by a Dutch botanist, Dr. Leeuwen, in the last number of the Annals of the famous botanical garden of Buitenzorg, in Java, enables naturalists to follow to a further stage the results of one of the most remarkable experiments made by Nature of which we have any record. Dr. Leeuwen's contribution is the most recent addition to a collection of facts, accumulated at intervals during the last thirty-six years, illustrating the capabilities of plants as travellers and as colonisers of bare ground. The author describes the vegetation of the small islands of Krakatau and Sebesi in the Sunda Strait between Java and Sumatra as he saw it in 1919 and 1921. A brief statement will suffice to show that the vegetation of these Malayan islands is, from a certain point of view, more interesting than that of any other region in the world. Lying about midway between Java and Sumatra is a group of islands including Krakatau, Verlaten, and Lang Island; between Verlaten Island and Sumatra is another island, Sebesi.

The Eruption of Krakatau

It is with Krakatau that we are primarily concerned. In the early part of 1883 Krakatau was five and a half miles long and three and a half miles broad; on the south side the peak Rakata rose to a height of nearly 3,000 ft. The whole of the island, from sea-level to the summit of the mountain, was covered with an impenetrable tropical forest. Krakatau was known to be volcanic, but it was believed to be extinct. In the course of the summer of 1883 the long-dormant volcanic forces awoke, and there were repeated explosions and showers of ash and pumice. Towards the end of August the climax was reached: at places in Java, 100 miles away, the noise of the explosions resembled artillery-fire at close range, and it is stated that sounds were heard on the island of Rodriguez 3,000 miles from Krakatau. Villages on the island of Sebesi, twelve miles distant, suffered the fate of Pompeii. Volcanic dust fell in enormous masses over a wide area, and some of the finer particles floated in the higher regions of the atmosphere round the world, causing, as I well remember, brilliant twilight effects in England in December 1883. When all was over it was found that two-thirds of Krakatau had been blown into space: the peak Rakata had been split from base to summit; a vertical precipice replaced its forest-covered slopes. The green island teeming with life had been converted into a lifeless desert covered

with volcanic ashes to a depth of from 90 to nearly 200 ft. We are assured by scientific men who visited the remnant of the island in 1883 that no living thing could possibly have survived. Thus ended a tragedy in which the actors were the volcanic forces hidden below a mountain clothed with a tropical jungle.

A "Miracle of Earth Re-clad"

From this stage onwards we are able, partially at least, to follow the steps of botanical reconstruction, to follow Nature as she "strewed flowers upon the barren way" and worked the "miracle of earth re-clad." In 1886, three years after the catastrophe, a Dutch botanist, the late Professor Treub, visited the island: he found a few pioneers already established on the beach and others in the interior of the island, both ferns and flowering plants. The plants near the sea had germinated from seeds washed up on the beach and carried from neighbouring islands by currents, while those farther inland possessed fruits or seeds adapted to dispersal by wind. Dr. Treub made the interesting discovery that the inhospitable surface of the volcanic dust and pumice had first been occupied by members of the Blue-green Algæ, small, lowly organised plants able to live under conditions which are impossible for the higher forms of life, and readily carried through the air in the form of minute, dust-like spores. These simple organisms covered the surface of the ground near the shore and in the ravines on the mountain slopes with a slimy film which enabled the spores and seeds of the higher plants to obtain a hold on life. It was afterwards found that bacteria and moulds were introduced at an early stage and played their part as an advance-guard for the army of more highly organised members of the plant kingdom.

In 1897, fourteen years after the sterilisation of the island, another visit was paid to Krakatau: sixty-two species of vascular plants were collected, that is, plants higher in the scale than mosses; since 1886 there had been many new arrivals and in places the ground was covered with vegetation. Nine years later, in 1906, a party of botanists spent some hours on the island, and a full account of their work was subsequently published by Professor Ernst, of Zürich, and translated into English. Professor Ernst wrote: "As we approached the east coast of Krakatau we noticed with growing amazement the remarkable progress made by the vegetation. Almost the whole south side, from the beach to the summit and to the edge of the steep promontory, is covered with green. On the south-east coast, where we first thought of landing, a belt of forest runs parallel to the shore, in which we could recognise from a distance numerous grey-green Casuarina[1] trees. Farther to the south rose the dark green

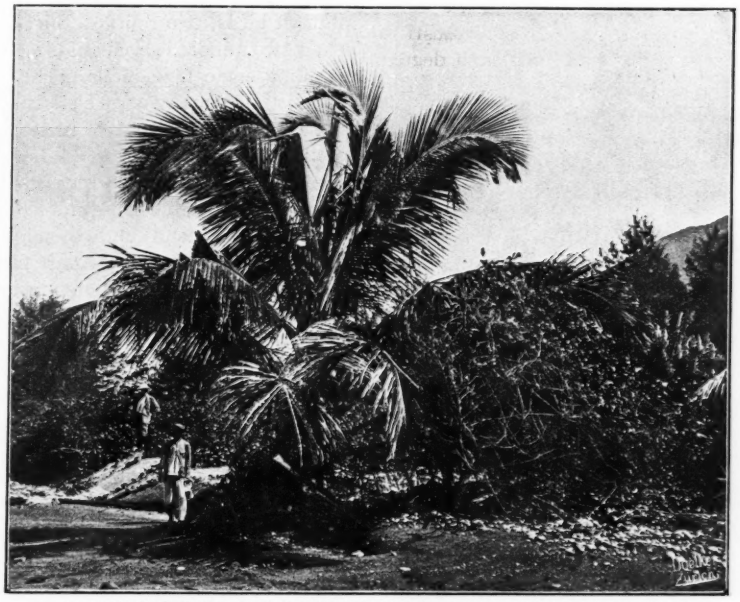

FIG. 1.—A COCONUT PALM ON THE BEACH OF KRAKATAU, PHOTOGRAPHED BY PROFESSOR ERNST NINETEEN YEARS AFTER THE ERUPTION.
By kind permission of the Cambridge University Press.

[1] Casuarina is a genus of trees represented by several species in Australia, Polynesia, and other regions in the Southern Hemisphere; it is characterised by green, pendulous, whip-like branches, and in some places is known as the She-Oak.

leaves of coconut palms in association with slender, broad-leaved trees bearing whorls of branches. Isolated trees and shrubs were seen on the low-lying ground which rises gradually to the base of the conical mountain ; in some of the ravines half-way up the hill they form patches of forest, reappearing as scattered plants on the higher ridges and on the peak."

Some of the trees had already reached a height of 49 ft. The beach was littered with the flotsam of the waves—fruits, seeds, and branches of common Malayan plants carried from Java, Sumatra, or other islands ; within this drift-zone the ground was festooned with

FIG. 2.—THE TALLEST TREE AND SOME DENSE VEGETATION ON KRAKATAU, ALSO PHOTOGRAPHED BY PROFESSOR ERNST.
By kind permission of the Cambridge University Press.

the trailing stems of a blue-flowered tropical Convolvulus and the runners of the grass Spinifex. Above the network of creeping stems rose shrubs of Hibiscus and many other plants, some of them covered with the thread-like stems of a parasitic Dodder. Ants, gnats, and wasps were unpleasantly abundant. One of Professor Ernst's photographs, reproduced in Fig. 1, shows a young coconut palm at the upper edge of the tide-level and, to the right, a shrub festooned with the stems of a Dodder (*Cassytha filiformis*). Fig. 2 affords an impressive illustration of the progress made by the vegetation : Professor Ernst's photograph shows the tallest tree, nearly 50 ft. high, supporting the climbing stems of a vine, and a belt of younger trees in the foreground.

The Return of Dense Vegetation and Animal Life

Dr. Leeuwen's visit to Krakatau in 1919, and in 1921 to the neighbouring island of Sebesi, which was almost completely devastated in 1883, furnished material of considerable interest. He writes of Krakatau : " The visitor who is not a naturalist, deceived by the dense vegetation now clothing the island, will fail to imagine and realise how at one time everything was destroyed and all plants and animals on the island were annihilated." A snake 18 ft. long was found, sixteen different kinds of birds, two reptiles, thirty-two kinds of spider, nearly two hundred species of insects, and other animals including some land-snails. The occurrence of land-snails is noteworthy as it has generally been supposed that they are restricted to migration-routes on land : they are apparently capable of taking a sea-voyage. Their presence on an island does not therefore necessarily mean either introduction by man or a former connection between the island and a neighbouring continent. Since 1906 the number of forest trees had considerably increased ; there were many more epiphytes, that is, plants which obtain a place in the sun by living on the stems of trees and have no direct contact with the ground ; also several additional Vascular Cryptogams—plants belonging to the group which includes the ferns, club-mosses, etc. The total number of vascular plants so far determined from Krakatau is 259, in addition to numerous lower forms of plant life.

" The key of the past, as of the future, is to be sought in the present " : by these words Huxley wished to emphasise the importance of exhausting all known explanations of phenomena before calling to our aid causes which are unfamiliar. The history of the botanical colonisation of Krakatau gives us the means of picturing similar processes at different stages of the world's history. The view adopted by Darwin in the *Origin of Species*, and now generally accepted, is that each kind of plant was first produced at one place ; it had a " single centre of creation." Leaving out of account the large part played by man in distributing plants, we must assume that the occurrence of the same species in widely separated regions means that it has travelled far from its original home. Darwin and other naturalists have contributed many facts based on observation and experiment which throw light on the ability of plants to be spread by natural agencies—by water, wind, and animals. The re-clothing of Krakatau with tropical vegetation from sources separated from it by several miles of sea is the most striking and illuminating example of the efficiency of plants as travellers and

as colonisers of bare ground which has ever been recorded.

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Is Tutankhamon Buried in the Newly Discovered Tomb?

By T. E. Peet, M.A.

Professor of Egyptology in the University of Liverpool

THE closing down of Tutankhamon's tomb for the summer postpones for the time being the solution of the question whether this king himself is actually buried within the nest of shrines. In the meantime a French scholar has made the disturbing suggestion that this is not the tomb of Tutankhamon at all, that having already been found elsewhere in the great valley. It may not be without interest to readers of DISCOVERY to be made acquainted with the facts on which this last statement is based.

In the winter of 1906 an American millionaire, Mr. Theodore Davies, who, with the late Mr. Edward Ayrton as his archæological expert, was searching for tombs in the Valley of the Kings, was attracted by a large rock tilted to one side, and on turning over the stones beneath and around it, found a small but beautiful cup of blue fayence bearing the name of Tutankhamon. This suggested that the king's tomb might be somewhere in the vicinity. It was not, however, until the following season that a tomb was found, a short distance to the north of that of Horemheb, which appeared to be that sought for. At a depth of 25 ft. below the surface a chamber appeared in the rock face, almost completely filled with dried mud deposited by the flood-water of centuries. In this were a magnificent statuette, perhaps a *ushabti*, of alabaster, and the remains of a wooden box containing several pieces of gold foil bearing in relief scenes of peace and of war, with the cartouches of Tutankhamon and his wife Ankhesenamon, and the names of the priest Ay and his wife Ty, these last without any royal titles. Ay was Tutankhamon's successor on the throne, only to be supplanted after a short reign by Horemheb, the founder of the XIXth Dynasty. At a short distance from this tomb a pit was found filled with large pottery jars which appeared to contain the debris from a tomb, and in particular the remains of funerary wreaths and garlands. The cover of one of these jars was broken and had been replaced by a wrapping of cloth bearing the name of Tutankhamon.

Such are the facts about the supposed tomb of Tutankhamon. They lend themselves to more than one conjecture. Mr. Davies believed that the tomb was that in which Tutankhamon was originally buried, that it had been plundered, and that when this was discovered the body and furniture were removed elsewhere for safety, such remains as were not considered worth moving to the new tomb being buried in a pit hard by. In view, however, of what may be discovered next winter, it would be foolish to indulge in further speculations now. The funerary furniture found by Lord Carnarvon appears to be that of Tutankhamon. The great wooden shrine is marked with his name, but we have as yet no information with regard to the inner shrines and the coffin which they may be reasonably supposed to conceal. We cannot be certain that the tomb was originally intended for him until we are assured that the inscriptions on its walls are in his name, and that the cartouches contain no alterations. This is not scepticism, but merely reasonable caution. Tyi's tomb contained not Tyi but Akhenaten, and that of Amenhotep II contained eight other royal mummies in addition to that of the true owner. Who can tell what incongruous changes may have been made by priests anxious to preserve royal bodies from plundering and desecration, or by religious enthusiasts eager to purge the country of the taint of heresy brought upon it by Akhenaten and his immediate successors?

If, then, the Carnarvon tomb is truly that of Tutankhamon, to whom are we to attribute that found by Mr. Davies? Certainly not to the priest Ay, for his tomb has been found elsewhere, in the Western Valley as it is called. There his great sarcophagus is still to be seen, and near it on the walls the portraits of the king himself and his wife, whose names have been carefully erased wherever they occur. Were they, then, followers of Akhenaten's heresy, or was it merely as usurpers that they earned the obloquy and persecution of later days? Probably the latter. It is clear, from the great stela which Tutankhamon set up at Karnak after his return from Tell el-Amarna to Thebes, that his reversion to Amon worship was complete and genuine. After a reign of probably little more than

six years [1] he was succeeded by Ay, the monuments of whose short reign (minimum four years) show every sign of rigorous orthodoxy.

The Davies tomb thus remains a mystery, and will continue to remain so should the new tomb, as seems probable, prove to be really that originally intended for and actually used by Tutankhamon.

Geological Results of the "Quest" Expedition

G. Vibert Douglas, M.C., M.Sc.

Geologist on the "Quest" Expedition

It was the original intention of Shackleton to explore those portions of the coast of Antarctica which lie south of the Atlantic and Pacific Oceans. To be precise, his first objective lay between Enderby Land and Coats' Land, his second objective between Charcot Land and King Edward VII Land. These two portions of coast have never been seen by man. On the routes to and from these objectives he intended to call at those seldom-visited islands in the Atlantic, Southern, Indian, and Pacific Oceans. This programme, while not of the spectacular nature of a dash to the interior of the continent, was one calculated to add considerably to our knowledge of the globe. Owing to the death of our leader, the unsuitability of the ship for ice navigation, and the conditions of the ice, only a portion of the last-named objective was attained.

The islands of Madeira, St. Vincent C.V., and St. Paul Rocks were visited on the way out, but space will not admit of their being mentioned here.

South Georgia

The island of South Georgia, which is 116 miles long by 20 miles wide, lies in lat. 54° S. 900 miles east of Cape Horn.

It was first sighted by Amerigo Vespucci in 1501, again by Antony La Roche in 1675, but was claimed for Britain by Captain Cook in 1775. After sailing around the island he recorded in his diary that it was unfit for human habitation, and he decided to call it the Isle of Georgia in honour of His Majesty George III. Little did he think that 140 years later it would give occupation to a thousand men and support so important an industry as the Southern whaling is to-day.

The physical features are those of an upland deeply eroded by glacial action. The highest peak, Mount Paget, is about 8,000 ft., but the average monument is only 2,000 ft., above sea level. The average valley elevation would probably be about 600 ft.

The glacial valleys run in general across the longer axis of the island, so that one sees valley after valley separated by comb ridges.

In the classification of Hobbs it is a fretted upland with the development through glacial action of monuments and comb ridges. There is some evidence of a general uplift, but in the opinion of the writer most of the low ground 50 to 70 ft. above sea level is the result of cosmic action rather than that of the sea.

In general it may be said that the glaciers show signs of withdrawal. One particular investigation was carried out at Royal Bay, where the Ross Glacier comes down to the sea. It was measured by the Gauss Expedition of 1882, again by Duse of the Nordenskjold Expedition of 1902, and by us in 1922—intervals of twenty years. These measurements show the fact that there was an advance of the foot of over 4,000 ft. during the period 1882 to 1902, and that now it is back in the position of 1882. It is suggested that this does not indicate any general advance or withdrawal, but rather that the glacier, to use an hydraulic term, is operating under a high head and is being forced out to sea, where the foot is afloat. It will continue to advance until the effect of the rollers on the floating mass of ice overcomes the tensile strength of the ice and it breaks away. If we assume that twenty years represent this period (it may be a multiple of a smaller period), then this gives an advance per year of about 220 ft.

Vegetation is limited to the lower slopes facing the sea, where there is plenty of tussock grass, which is capable of supporting, and does support, imported reindeer. There are ferns and lichens growing in the crannies of the rocks. Lettuces, radishes, and carrots are grown under glass at Husvik.

The greater part of South Georgia is composed of sedimentary rocks, but running inland from Cooper Bay there is an igneous contact. To the east of this contact an igneous complex exists.

The sediments,[2] which are of the nature of mudstones, shale, slate, phyllite, quartzite, greywacke,[3] marble, and tuff, most probably represent one great series of deposition. Owing to a complicated series of folds, faults, and sheared zones in many places, one would think that an unconformity existed and, until there has been more detailed work done on the island, it will not be possible to say definitely whether there are two main series or only one.

The sediments have been so contorted that most of

[1] The statement in my article in DISCOVERY, No. 38, p. 32, that we have no year dates of Tutankhamon needs correction. In the tomb of Tyi was found a vase containing a piece of linen on the edge of which was written in ink "Year 6 of Tutankhamon."

[2] Mr. G. W. Tyrrell, A.R.C.S., F.G.S., Glasgow University

[3] Dr. W. T. Gordon, D.Sc., King's College, London.

the fossil evidence has been destroyed. A petrified stem of an Araucaria was found on an island in the Bay of Isles and would point to an age not later than Lower Carboniferous.[1] An examination of some of the slates has been carried out, but yielded no evidence of great importance.[2]

With regard to the igneous geology of the island,[3] two areas were studied. North of Drygalski Fjord, there is an interesting complex consisting of :

Quartz diorite plug, Two ages of gabbro } Complex system of dykes (peridotite, vogesite, dolerite).

A little to the south-east, but forming part of the same area, there are twelve parallel dykes. The lower one of these was reached and proved to be differentiated, gradually grading from wall rock, which was a gabbro, to a quartz diorite, a biotite granite, and finally alaskite. At Larsen Harbour, which is on the south side of Drygalski Fjord, the rocks were more basic.

Epidosite (on top), Spilitic lava, Gabbro } Two systems of doleritic dykes.

It is believed by the writer that the lavas were poured over gabbro, or, in other words, the gabbro is not intrusive into the lavas.

The general strike of the rocks is parallel to the longer axis of the island, and the dips are mainly toward the south-south-west. The folding and faulting on the north-east coast are thought to be the result of pressure either from the south-south-west or north-north-east.

Zavodovski, South Sandwich Group

This island was not landed on, but the following observations were made from the ship.

The island appeared to be a volcanic cone rising to about 1,200 ft. At the base there was a compact columnar basalt.[4] Above this, a line of red cinder, and above this, rough pahoehoe lava forming the surface. Sulphurous fumes were issuing from cracks in the cliffs at one or two points. The rock fragments brought up by the Kelvin sounding machine confirm the basaltic nature of the rock.

[1] The Carboniferous period is one of the subdivisions of the Palæozoic period, which yields the remains of the earliest living things.

[2] Dr. G. L. Elles, D.Sc., Newnham College, Cambridge.

[3] Igneous rocks are those which have been erupted from below the earth's crust—an example is granite. They are classified according to the amount of silica which they contain. Thus gabbro contains about 50 per cent. ; quartz diorite, 65 per cent. "Basic rocks" are those which, like gabbro, contain the least silica.

[4] Basalt is an igneous rock. The isle of Staffa is mainly composed of it ; the tall black columns are typical of this rock.

Elephant Island, South Shetland Group

The topographical features of this island are those of a dome-shaped plateau, 300 ft. at the rim and rising gradually to 1,200 ft. in the interior. It is covered in an ice sheet. The glaciers appear to be more of the hanging type than of the valley type.

The observations of J. M. Wordie[5] on the north coast, and our observations at Minstrel Bay on the west coast, would indicate that the northern part of the island is composed of contorted siliceous phyllites.[6] The strike of the rock strata is about N. 95° E. with vertical dips. No faulting was observed, but horizontal jointing was commonly met with.

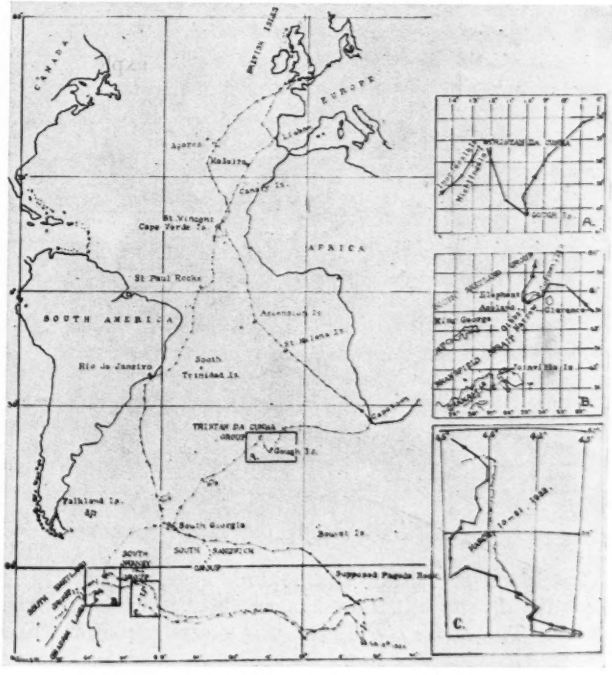

FIG. 1.—MAP OF THE *QUEST'S* TRACK.

At Cape Lookout, however, an entirely different set of conditions was seen. There is here a metamorphic series, which consists of the following in order from the sea towards the north[7] :

Quartz hornblende epidote schist.

[5] James M. Wordie, M.A., "S.y. *Endurance*."

[6] Phyllite is one of the metamorphic rocks. These are rocks which were either originally igneous or deposited by sedimentation from water, but have been modified by heat or crushing, and differ widely from their original forms. Quartz, hornblende, albite, etc., are various forms of the element silicon—familiar to us in the form of flint—in conjunction with soda, aluminium, iron, etc.

[7] Dr. C. E. Tilley, Ph.D., Cambridge.

Garnet albite schist.

Garnet albite schist with mica and hornblende banded with a sandy limestone.

Tristan da Cunha Group

This group, consisting of the five islands, Tristan, Nightingale, Middle, Stoltenhoff, and Inaccessible, lie in lat. 37° S., long. 12° W., which is about 1,500 miles west of Cape Town.

It was discovered by Tristan da Cunha about 1508, but only became inhabited about the beginning of the nineteenth century when Napoleon went to St. Helena.

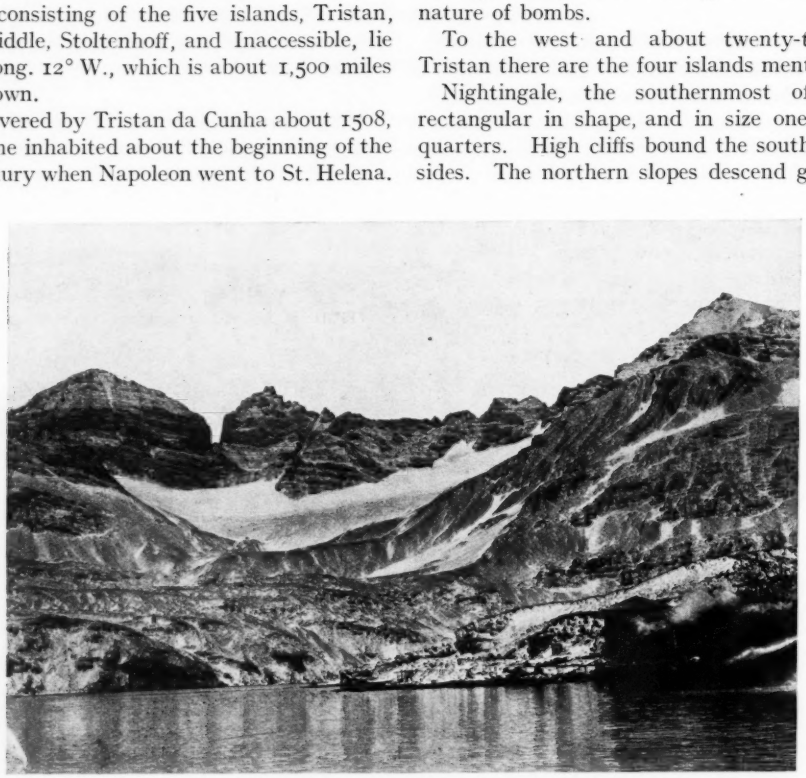

FIG. 2.—TYPICAL SEDIMENTARY ROCK SCENERY, PRINCE OLAV HARBOUR, SOUTH GEORGIA.

The island of Tristan is a volcanic cone rising to 6,400 ft. In shape it is an octagon about eight miles across. The first 2,000 ft. are very steep, but after this the slope is 17° or less.

At 3,200 ft. the slopes become deeply indented with drainage ravines. These continue for about 500 ft., when the slopes become very rugged with minor rocky knobs. This rough surface continues up to 5,700 ft., where the final cinder cone begins. The old crater at 6,300 ft. now forms a snow-water lake. The vegetation line is about 3,800 ft. above sea level.

The mountain is built of successive flows of lava mainly basaltic in character. Many vapour vents occur, and the rock varies from compact to very vesicular in texture. The lowest lava forms a lava plain at the north side of the island, and this plain has a number of small cones which represent the second and last stage of vulcanism. These observations were made on the line of section from the Peak to Herald Point and westwards to just beyond the Hardy Rocks. That a more complex state exists in the neighbourhood of Swain Bay is evidenced by the specimens given by the islanders to the writer. These might almost be said to be plutonic, but it is thought [1] that they are of the nature of bombs.

To the west and about twenty-two miles from Tristan there are the four islands mentioned above.

Nightingale, the southernmost of the four, is rectangular in shape, and in size one mile by three-quarters. High cliffs bound the south, east, and west sides. The northern slopes descend gradually to the sea, where they terminate in cliffs about 50 ft. high. The highest point is on the east of the island and is about 1,000 ft. above sea level. It is connected by a low-featured col to the high land on the south-west. To the west, that is towards the interior of the island, there is a depressed area which has now a small pond in it. It is probable that this was once the crater from which the lavas issued. They are mainly composed of trachyte—a volcanic rock which is common in Scotland.

Middle Island lies less than half a mile to the north of Nightingale. It is about a quarter of a mile square and rises to a height of about 200 ft. It is flat-topped with minor depressions.

There have been questions asked as to the origin of Middle Island, and to the writer, who had this in mind

[1] W. Campbell Smith, M.C., M.A., Brit. Mus. (Nat. Hist.). Plutonic rocks are those which have been thrust through overlying rocks from below in a liquid condition. Bombs have been cast forth as round masses from volcanoes.

when visiting the island, the following were the reasons for its existence. The flows of light-coloured lava from Nightingale probably extended at one time about a mile farther to the north than the present northern shore of Nightingale. This is evidenced by the trachytic agglomerate and trachyte seen on Middle Island. Following this there was an effusion of a hard compact lava from a neck which exists on the latter island. The border of the neck is marked by a breccia. The dykes emanating from this lava are not seen on Nightingale, but some of the rocks which infest the channel between the islands are probably their eroded remains. The action of the sea on the mass of altered trachyte between Middle and Nightingale has in the course of time cut a channel through.

Stoltenhoff Island

It is not possible to land on this island as it rises sheer from the sea to about 200 ft. It is flat-topped and in area about 500 yds. by 150 yds. The rock of which it is composed appears to be of a trachytic nature and may be the northern limit of the flows from Nightingale which have already been mentioned; it may, however, be a centre of activity such as is described as existing on Middle Island.

Inaccessible Island

Eleven miles to the north-north-west of Stoltenhoff is this island, which is the most northerly one of the group. It is pear-shaped in appearance, being about three miles by two and a half miles.

In its general features it is a basin—a great caldera the south-eastern side of which has been blown out. A cone rises to about 1,500 ft. towards the north-east of the depressed central area. The interior is broken country clothed in verdure, and on account of the high rim, which affords protection from the winds, would be suitable for human habitation. A stream winds through the interior, finally falling in a beautiful cascade, to the beach at the north-east shore, where a landing is easily made if the wind be not from the north.

The central cone is a mass of light frothy lava, and the section from here to the sea near the waterfall shows that there have been successive flows of basalt and trachyte. The high cliffs to the west of the landing are cut by a series of parallel dykes which are an imposing feature.

Gough Island

Gough Island lies roughly 280 miles south of the Tristan da Cunha group. It is eight miles long by three miles wide, and forms a monoclinal block with dip slopes to the west and escarpments to the east. The highest point on the long ridge which runs down the longer axis of the island is about 2,915 ft. above sea-level. The west side of the ridge goes down in a long slope to the cliffs bordering the sea.

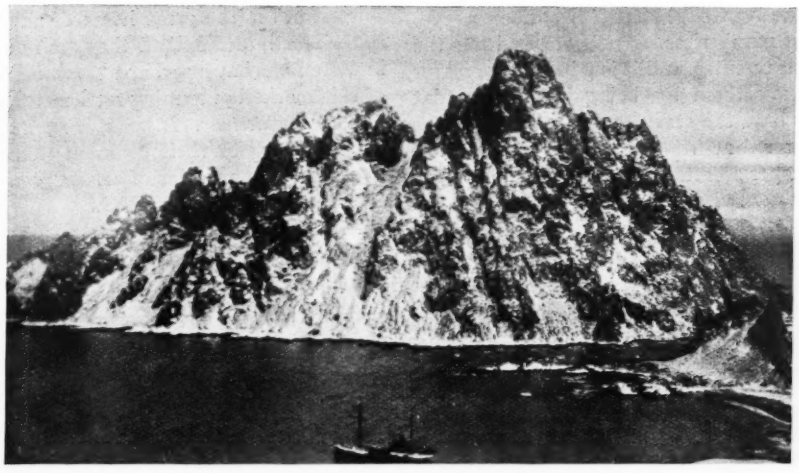

FIG. 3.—LOOKOUT HARBOUR, ELEPHANT ISLAND.

The escarpments on the east side are cut by three or four glens; the largest one, about half-way down the coast, gives access to the interior. The most striking feature looking up the glen is the great stock of an acid intrusive rock which rises to 2,270 ft. It can best be described in the words of Scott:

> "Shooting abruptly from the dell
> Its thunder splinter'd pinnacle."

Thick mosses and bracken grow in the glens and two types of tree were found. In the smaller glen, to the south of the main one, there is a species of Sophora,[1]

[1] G. H. Wilkins, M.C., F.R.G.S., Naturalist.

which is the farthest point south at which this tree has ever been reported. The other and more hardy tree is a type of Phylica.

The island is the result of a series of fissure flows of a basaltic and trachytic nature. These flows have been intruded by the stock just mentioned above, and many fissures were opened by it; these have subsequently been filled by dykes. The rock forming these dykes is very hard, with the result that they are now a very prominent feature and stand up in some cases about 50 ft. above the surrounding country, due to differential weathering.

It is probable that the east coast represents a fault plane, but as the erosion has been great, direct evidence is wanting. Apart from this fault, no folding nor faulting was observed.

The expedition then proceeded to Cape Town, where it received orders to return home.

Looking back over the many miles traversed, where mighty forces are working unseen by human eye, memory discloses numberless open doors inviting the adventurous spirit to enter, and it is with sincere regret that we had to pass them by, being well aware that Nature has laid bare the story of her history to the careful investigator, but from the casual observer she withholds her deeper secrets.

Some Types of English Place-names

By Allen Mawer, M.A.

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PLACE-NAMES denoting human habitations, as distinct from those which are applied to natural features, may roughly be divided into two main types. There are those which are descriptive of the site of the place itself and those which primarily take their name from their founder, owner, or tenant, even though the suffix may be more or less vaguely descriptive.

The latter are as a rule a good deal more interesting than the former, for the personal name is seldom more than a name to us. It is only very rarely that we can with any measure of certainty identify the person with any well-known historical character. There are few cases like *Bamburgh*, which we know to have been called after *Baebba*, the queen of Aethelfrith of Bernicia, or *Portsmouth*, which, if the legend be true, preserves the name of *Port*, one of the leaders of the Saxon invasion of Hampshire.

Place-names Based on River-names

Of the former type the earliest are undoubtedly those which are based on river-names. In grants of land in Saxon times we find, again and again, that the land was given, not as it would now be, at such and such a place, but by such and such a river—Stour, Avon, or whatever it may be. This practice has left a deep impression on our place-names. Sometimes, as in *Watchet*, *Frome*, and *Darenth*, the river-name has in course of time come to be tied down to one place on its banks. More common, at least in certain parts of the country, is the practice of applying the river-name to a whole series of settlements on its banks, and then distinguishing them from one another in later times by prefixing or suffixing some second element. Hence we get such series as *North Cray*, *Foots Cray*, *St. Paul's Cray*, *St. Mary's Cray* in Kent, the Wiltshire *Winterbournes*, the Gloucestershire *Colns*, the Devonshire *Clysts*. Dorsetshire is the great home of names of this type; in the North of England they are notably absent, but in Essex we have perhaps the most curious example of this method of naming settlements on a river. The names *Ingatestone*, *Ingrave*, *Frierning*, *Margaretting*, *Mountnessing* in their common element, namely *ing*, reveal all that remains of an old river-name which lies behind the present-day *Wid*.

Most common of all, however, are those cases in which some *ton* or *worth* or *wick*, or whatever else it may be, has taken its distinctive name from the river on which it stands—*Cirencester* from the *Churn*, *Frampton* from the *Frome*, *Davenport* from the *Dane*. Names of this type are of more recent origin than those just discussed, as is happily illustrated in *Bledington* in Gloucestershire, on the *Bladen* (now called the *Coln*). In the earliest reference to it it is called *Bi Bladene*. Very curious are some of the transformations which some of the river-names have undergone, obscuring the whole history of the names involved. An early river-name *Alum* in Somersetshire gave rise to an *Alhampton* and that in its turn has given rise to a river *Alham*. Who would suspect that *Dewlish* in Dorset takes its name from the original form of the name of the river on which it stands, now called the *Devil's Brook*, or that the same river-name has given rise to the *Devil's Water* in Northumberland and forms the first element in the name of *Dilston* on its banks? The old river-name *Gifle* (pronounced *Yivle*) is found in *Ilchester* (earlier *Givelceaster*), *Yeovil* and *Yeovilton*. These all stand on a river now called *Yeo* rather than *Yeovil*, as it ought to be called. Some ingenious person could not apparently be content with a town called *Yeovil* without making it into the *vill* on the *Yeo*. The same river-name lies behind *Northill*, *Southill*, and *Yielden* in Bedfordshire.

Side by side with such names as these we have others which attempt to show the precise position of places in relation to a river or rivers. The *Mittons, Muttons,* and *Mytons* are all on the *mythes* (a derivative of *mouth*) between the meeting of two streams. *Twining* in Gloucestershire means "Between two streams," and so did *Twyneham,* the present-day Christchurch. The North Country *twistles* are all at the *twisel* or fork of two streams, while *Beckermet, Beckermonds, Eamont,* and *Emmott* are all at the "meet" or "moot" of two becks or rivers (Anglo-Saxon *ea*).

Names Compounded with "At"

One curious trick of Old English place-nomenclature, going back to very early times, was the method of speaking of a place, not as "X" but as "At X." In large numbers of charters the regular formula is that the grant is made at the place "which the rustics call 'At X.'" One shrewdly suspects that this was by then nothing but a legal formula and that it was the lawyers rather than the rustics who thus called it. The old custom has, however, left its very definite mark in place-names. Dr. Bradley long since pointed out that the many English river *Rees* or *Reas* went back to Middle English *at ther ee* (= at the river), becoming by misdivision *at the ree. Thurleigh* in Bedfordshire, pronounced *Thurly* with the stress on the last syllable, is a yet more curious instance. Its early forms are variously *Leye, Therlye,* and *Relye.* All can be explained from an early *at there leye* (= at the meadow), alternatively misdivided to *at the relye, at therlye,* or, with no preposition or article, simply *Leye.* The importance of these misdivisions in giving rise to fresh place-name forms is neatly shown in a Buckinghamshire charter which mentions *Yttingaford,* the scene of the peace between Alfred and Guthrum, and a road called the *Theodweg* (i.e. the national road). Mr. Gurney of Egginton has identified these as *Tiddingford* Hill, where the *t* of *at* has got tacked on to the front of the name and *The Ede Way,* where the initial *th* has with equal ingenuity been chopped off.

Descriptive Place-names

Another very common type of place-name is that whereby the position of a group of settlements is defined in relation to some common centre or in relation to one another. These *Nortons, Suttons, Eastons* or *Astons,* and *Westons* call for little comment as a rule, though when one or other of the group has dropped out it is often difficult to tell now just why the place is so called. It is noteworthy, however, that the essential vagueness and ambiguity of such names led to curious intensive forms. Side by side with *Westons* and *Astons* we have the comparatives *Westerton* and *Asterton,* and even the superlative *Westmeston.* There are three *Middletons* in Ilderton in Northumberland, and one is commonly distinguished in early times as *Midlest* or *Midelmast Middleton.*

It is clear that our forefathers were a good deal more sensitive than is the average man of to-day to differences of slope and outline. They applied the term *cliff* to many a slope which to our eyes is but a gentle rise (e.g. *Egglescliffe,* co. Durham), and it did not require any very steep gradient for them to call places *Hanging Houghton* or *Hanging Grimston,* or to call a wood a *Hanger,* the source not only of a good many names in *-hanger,* but also of the many *Hunger Hills* scattered up and down England, and probably also of the *Hungry* in *Hungry Bentley* and *Hungry Studley,* now *Studley Royal.* The Anglo-Saxon *hoh* meant originally "a steep overhanging cliff" (allied to the word *hang* itself) and is still found in this sense in the North Country *heugh,* but it is curious to find it, in the form *-hoe* or *-hoo,* applied also to the low spurs of land jutting out into the flats of Bedfordshire and Northamptonshire. This sensitiveness to slight changes of shape has made it at times very difficult, as in the case of the very common suffix *hale,* to determine the precise sense in which certain terms were used. Dr. G. B. Grundy in his work on Saxon Charters has shown how much may be done in this matter by tracing out the bounds of an estate as given in a charter on the actual ground itself

Form and Colour in Place-names

Questions of outline are clearly the cause of many hill-names. *Brokenborough* is fairly common as a hill-name, so is *Holborough* (*hol* = hollow). Less obvious are *Clannaborough* (= cloven hill) and *Sadberge, Sedbergh, Sedborough,* and *Sedbury,* all of which denote a *seat*-shaped hill. The suffix in all these cases is originally *beorg,* "barrow, hill" rather than *burh. Hambledon, Homildon, Humbleton* and the like are fairly common as hill-names in England. They are all *hamble*-hills in which the first element goes back to an Anglo-Saxon *hamel,* "mutilated," and they refer to various types of outline, one of the commonest being the rounded or "dodded" hill. *Cronkley* in Northumberland and *Crunkley* in the North Riding both go back to an early *crumbeclif* descriptive of a hill of *crum* or "crooked" outline.

There has been much discussion as to how far we are justified in carrying this idea of the use of descriptive place-names by our forefathers. In reaction against an earlier unscientific school of place-name interpretation which hunted for the picturesque, quite regardless of scientific truth, there has been an inclination on the part of some scholars to deny it almost entirely, and to try to get round the difficulty of interpretation with the aid of personal names, real or imaginary. Others would confine this type within the narrowest limits, and in

any case deny the possibility of there being any question of æsthetic considerations, even in the broadest sense, in the giving of names to places.

There is little doubt among scholars at the present time, however, that descriptive names did prevail to a much larger extent than has been generally allowed. There may have been personal names *White, Black,* and *Brown* in Saxon times, but the mass of evidence goes to show that proportionately they were nothing like so common as those elements are in place-names, and we may therefore assume that in place-names they are very often of purely descriptive force. *Green* and *Red* and *Grey,* the first two of which often appear in place-names as *Grin-* and *Rad-,* are quite unambiguous in early times, for they are not used as personal names in Old English, though *Red* in the form *Routh* is fairly common as a Scandinavian personal name and nick-name. We have a good many place-names which are due to the attempt to record the existence of red cliffs, usually of sandstone. *Radcliffe, Ratcliffe, Redcliffe* are of English origin, while *Roecliffe, Rawcliffe,* and *Rockliffe* are similar names in Scandinavian districts. The adjective *har,* "hoar," "grey," is curiously common in place-names. It may in some cases be doubtful whether we have this adjective or the animal-name *hara,* "hare," but there are far too many cases of this element *Har-,* quite apart from those cases where it is a later development of Anglo-Saxon *here,* "army," to allow of its being commonly taken as the animal-name. Specially common are *Harstons* and *Hoarstones, Hoarwood* and *Harwood, Harwell* and *Hartrow,* in none of which is the animal-name very likely. The adjective *har* was primarily applied to anything that was "grey" or "covered with lichen," and then, at least in the case of *har-stan,* developed the secondary sense of "boundary" (stone). Judging by the large number of *Harwoods* and other places in *Har-* which now lie on the boundary of two parishes, there is some reason to think that this secondary sense may have been extended to other compounds. Lastly, among adjectives of colour we may mention the use of Anglo-Saxon *fah,* "stained," "variegated." This is fairly common in place-names, and does seem to show an appreciation for the finer niceties of colouring in the landscape. We get it in numerous *Fawleys* and *Fawdons* and in *Fawler.*

Names showing a Sense of Beauty

Definite appreciation of æsthetic considerations is shown by the use of the Anglo-Saxon *faeger* (= fair) in names like *Fairford* and the not uncommon *Bright-* in names like *Brightwell,* descriptive of a sparkling spring. Any suspicions that we might have that the first element was a Saxon personal name *Bright* are happily removed by the Latinising of the name in a Saxon charter as *ad declaratam fontem* (at the bright well). So also we get the Anglo-Saxon adjective *myrig* (= merry), "pleasant" in *Merrils Bridge* (Notts) and *Moralhirst* (Northumberland), in both of which the first element is Anglo-Saxon *myrige hylde,* i.e. "pleasant slope," a phrase which is closely paralleled by a *faeger hylde ford* in a Saxon charter.

The frequency of the river-names *Blyth* and *Lyde,* which Dr. Ekwall has shown us are nothing but the adjectives *blithe* and a lost adjective *lyde,* a derivative of *loud,* would seem to show that our forefathers were not quite insensible to the cheerful sound of a running stream.

The great frequency of names in *Broom,* whether used by itself or in compounds (usually as *Brom-*), would suggest that they found delight in a golden patch of broom, and similar delight in an English hedgerow is suggested by the large number of names in *Hep-* and *Hip-* which go back to the Anglo-Saxon *heope,* a "hip" or "dog-rose." Close observation of nature is suggested by *Lemmington,* earlier *Lemeke-ton,* i.e. brooklime farm, in Northumberland, and *Gomer* in Hampshire, earlier *Galmore,* which is really the "swamp where the *gale* or bog-myrtle grows." It is curious to note how often a name in *-well* contains as its first element a bird-name, ranging from the *crane* in *Cranwell* and *Cornwell* and the *crow* of *Crowell* to the tiny wren and throstle found in Saxon names which unluckily do not seem to have survived to modern times. Such names indicate careful observation of nature, and many other examples might be given. Attempts to show that in these names we are really concerned with persons named *Hawk, Crane, Crow* and the like break down entirely, at least so far as the material goes back to Saxon times, for animal-names are extraordinarily rare then. The trick of nicknaming a man from some bird or beast was first taught us by the Vikings and does not begin to show itself to any appreciable extent until the latter part of the tenth century.

The suggestion has been made that the French invaders of the eleventh century first taught us to have any appreciation for scenery, the ground for this being that many of the names of French origin in this country describe a pleasing prospect. This seems to be a very doubtful proposition. To me there seems to be a certain monotony about names of French origin. They hardly ever venture beyond the somewhat colourless epithets of *Beau-* and *Mal-.* There are many *Beaumonts,* two "fine headlands" (*Beauchief* and *Beachy Head*), a "fine brow" (*Beaufront*), two "fine deserts" (*Beaudesert*), two *Beaulieus* and a *Bewley,* a *Belvoir,* some "fine retreats" (French *repair*) disguised as *Belper, Beaupel, Bear Park,* and plainer as *Beaurepair,* a *Beauvale,* several *Belasis, Belsize,* and *Bellasize,* a *Butterby* which is really *Beautrove,* "beautifully found," and a *Beams* and *Beamish* which

go back to Latin *bellus mansus*. Opposed to these we have *Malpas*, "bad ford," an interesting successor to the earlier English name of "Deep batch" or "stream," *Malsis*, "the ill-placed seat." There is a nice touch of humour in the Essex *Beaumont* which replaces an earlier English "Foul pit." Even if we throw in *Hautbois*, *Montacute*, and *Egremont* it would seem that, from the point of view of picturesqueness and appreciation for natural detail, the French names mark not an advance upon, but a decline from, the native English standard.

Nick-names as Place-names

Finally we may deal with the question of the existence of names which in the sphere of place-names take much the place which nicknames do among personal names. They are not common and there is very little evidence for their use in Saxon times. So far as they find their place on the modern map they may be suspected to be of Middle rather than Old English origin, were very probably influenced by the more picturesque methods of naming prevailing among the Vikings, and were undoubtedly often in the first instance names of fields, which afterwards were extended to whole farms and the like. Of this type we may mention *Unthank* used of land which is "ungrateful" towards its cultivator, *Snapegest* or "Snub-stranger" which may have been of similar import or was possibly applied to a farm where vagabonds received no friendly welcome. For many of the most picturesque names no early forms are found, and exhaustive study of the history of such in two English counties convinced the present writer that many of them were created out of nothing, so to speak, somewhere about the middle of the eighteenth century and onward. Names like *Glororum*, used of a commanding situation which "glowers" over the neighbouring country, *Make 'em Rich*, used of a prosperous farm, *Click 'em in*, a common inn-name, *Peep o' Sea*, used of a farm with a glimpse of the sea, are self-explanatory, and one would be wrong in these names or in such a name as *Pity Me* to fancy that these strange names hide, as has been sometimes suggested, some long-lost and well-concealed British name.

BIBLIOGRAPHICAL NOTE

In the above article all interpretations of names are based upon a study of their earlier forms, and no theory is based on names for which we have only modern forms. At the present time there is no general book dealing with the problem of the types and varieties of English Place-names, but the *Introduction to the Survey of English Place-names*, to be published some eighteen months hence by the *Survey of English Place-names*, will deal with many of them. At the present time the book which gives the best picture of modern tendencies in the interpretation of place-names is that on the *Place-names of Lancashire*, by Dr. Ekwall, published in 1922 as a volume in the Chetham Society's Publications and also as a separate volume by the Manchester University Press.

Ball Games in Ancient Greece

By Stanley Casson, M.A.

Fellow of New College, Oxford

EARLY in February last year a discovery was made in Athens which will rank as one of the most remarkable finds of Greek sculpture ever made. In a fragment of the city wall on the west side of the town, near the so-called Theseium, two statue-bases were found built up into the wall. Each measured approximately 80 centimetres square and some 30 centimetres in height, and was of fine Pentelic marble. In each case three faces of the bases were adorned with sculptures in fine low relief; the upper surface showed the sockets for the insertion of the feet of a statue, and the lower surface a square dowel-hole for the insertion of a foundation dowel. The bases had, in all probability, formed the summit of some rectangular foundation structure.

A third basis of exactly the same type, but with only one face decorated, was also found embedded in the same stretch of wall, but in this case the decoration had been in paint and there had been an inscription. Both painting and inscription had been deliberately defaced in the days of antiquity.

Scenes of Athletic Life

The first two bases were decorated with scenes descriptive of the athletic life of Athens. All three have been published.[1] The purpose of this article is to examine the meaning of one face of one of the bases only, since the general meaning and description of the reliefs has already been given in the various publications that have already appeared.

The base in question has on the left side a relief showing six young men standing in different positions which are all vigorous and active. All the men are naked, but their hair is carefully and neatly arranged in short curly locks except in the case of the man on the extreme left, whose locks hang loose over his shoulders.

The central of the three reliefs shows two men wrestling and two others standing near, one apparently keeping the ring and in a position to prevent the wrestlers from pushing each other beyond its limits, the other standing ready with a measuring pole to judge the distance of a throw.

[1] In *Journal of Hellenic Studies* (1922), p. 104, and *Bulletin de Correspondance Hellénique* (1922), p. 1, by A. Philadelpheus, and in *Dedalo* (September and December 1922) by A. Della Seta.

The right relief shows a quieter scene in which two youths sit on chairs and hold on leashes a dog and a cat respectively on the left and right of the centre. Behind the chairs on each side another youth is leaning, looking on. Each of the figures is clothed in a long garment.

The relief which seems most difficult to explain, and which in fact has not been explained, is that above described first as on the left side of the base. The six athletic figures have been accounted for in various ways as dancers, as athletes each representative of a different form of athletics, and as ball-players. No definite attempt, however, has been made in the last case to ascertain what type of game they are playing, whether a team game or one in which only one at a time can play, and whether the game corresponds to any of the known "official" games of public festivals, or whether it is one of the ordinary games of every-day life in the palæstra.

A close study of the relief itself shows that the players are grouped round an imaginary central line which divides the relief into two equal parts. The three men on the left seem to be advancing, those on the right retiring. The six thus form two teams of three. The foremost on each side is moving at a moderate pace, the central figures at a faster pace, and the figures at the back of each team at a slow pace, almost a walk. To use modern "Rugby" terms, they might be called "forwards," "three-quarter-backs," and "full-backs." The team that appears to be advancing has possession of the ball, which is a small one and is held in the hand of the full-back.

It remains to be asked, then, whether there is any record of any such game in literary or other sources in the ancient world.

The solution seems to me to be given in a passage in the well-known work of Julius Pollux called the *Onomasticon*, a work which might be described as a "young man's guide to university life." This work is dedicated to the Emperor Commodus and, in consequence, must have been published shortly before A.D. 177. It is written in Greek and is concerned largely with things Greek. Its author had studied at Athens in the university, and can, therefore, be considered as in some ways an authority upon Athenian life in the days when old traditions were being revived.

In the ninth book of the *Onomasticon* one section is devoted to games, both of children and of young men. Four games of ball are mentioned—*Phaininda*, *Aporraxis*, *Urania*, and *Episkyros*.

The Athenian Form of Rugby

Episkyros is the only team-game mentioned in which a ball was used. It was a "ball-contest" (*σφαιρομαχία*) rather than a "game" (*παιδιά*) for individuals. According to Pollux it was played by young men rather than by children. The players were divided into "two teams of equal numbers facing each other or separated by a central chalk-line." This chalk-line, or "half-way" line, in the language of Rugby, was called the *skyros*, another word for chalk. The ball was placed on the central line, as in a "kick-off," before the game began. There were two other lines drawn behind the central lines that seem to correspond to the "twenty-five" lines of Rugby football, but they were used in the same way as the "back-line," and formed the back limit of the area of play. The game presumably started by the ball being seized by one side or the other and thrown in the direction of the opposing "back-line." The team that held the ball had to avoid being pushed over the "back-line."

The description is brief and summary and many essential details are omitted. We are not told how the game starts, nor whether the players of one team are allowed to pass the ball from one to another, nor what precisely constitutes a win. Probably the team that held the ball had to get rid of it as soon as possible by throwing it in the direction of the opposing goal, and following up with a charge which would hustle the opposing team over their own "back-line" before they had time to get rid of the ball themselves. In any case the main point of the game seems to have been to avoid keeping the ball, since the team that held it was at a disadvantage: in this respect the game differs from our own games of football. The description given by Pollux is short and condensed, chiefly because his work was a dictionary packed with condensed information and not an explanatory treatise. At the same time it seems doubtful if he really understood the game he was describing.

This game of *Episkyros*, or "the chalk-line game," seems to explain our relief. Here we have two teams of equal size divided by a central line. The team on the right has just thrown the ball, which has been caught by the full-back of the opposing team and is being thrown back before the attacking team has time to charge. The team in possession of the ball is, in its turn, preparing to follow up the throw of its own back by a charge which may succeed in hustling the opposing team over their "back-line." The full-back who holds the ball is just about to launch it in the direction of the other team: his "outside" or "three-quarter" is preparing to follow up at full speed, while the "forward" is advancing judiciously so as to fall back as a defence in case the opposing team counters the move by throwing the ball back again quickly. It is evident that the team which *catches* the ball is in a position of advantage over the team who have to *pick*

it up from the ground, since in the former case the ball can be thrown back as soon as received. The main function of the "full-back," then, is to be able to catch and to throw.

In the team that is retiring the same division of duties can be detected. The "forward" is retiring cautiously, ready to advance again. The "three-quarter" is alert, ready to move in any direction, and the "full-back" is waiting to catch the ball and throw it back. In addition, the "full-back" seems to be the captain: his left arm is extended as though he were signalling to the "forward" to fall back. It is, I think, no mere coincidence that his gesture corresponds to the modern Greek equivalent of our own gesture of beckoning. The hand is turned down and makes a sweeping downward motion.[1]

The general correspondence of the sculptured scene with the game described by Pollux thus seems evident. No element of the game as described by Pollux contradicts what we have in the relief. On the other hand, we learn from the relief much that seems to supplement what is in Pollux. Thus the division of functions of the players, the counter-throw of the team that has received the ball, and the important position of the "full-back," who acts both as captain and principal defender, are points which are not indicated by Pollux but which yet agree with his account.

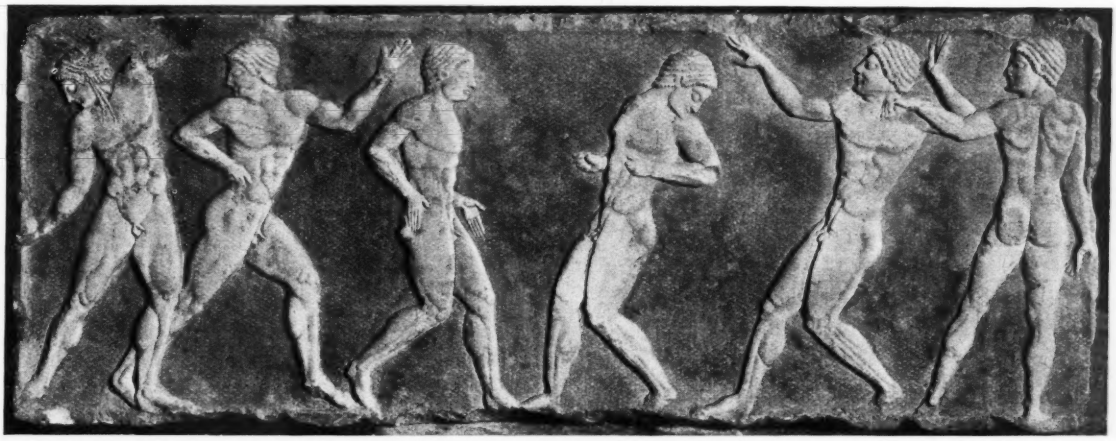

FIG. 1.—THE ANCIENT ATHENIAN EQUIVALENT OF RUGBY.

Other Greek Ball Games

A few general considerations need attention. Of ball games in general we know little outside what Pollux tells us. The second of the newly discovered bases shows us a ball-game hitherto unknown, resembling hockey. From inscriptions in Sparta comes much evidence as to the contests of teams of ball-players,[2] but unfortunately there is little to enable us to tell the nature of these Spartan games.

It is, of course, possible that Athens derived many of her non-Olympian games from Sparta itself. The games of the everyday life of the palæstra, called by the Greeks παιγνίαι, were said by the Lydians to have been learnt by the Greeks from Lydia.[3] Lydia, we know, was in the closest possible touch with Sparta in the seventh and early sixth centuries B.C., and it seems probable that Sparta was the home of the ordinary athletic game. The game of *Episkyros* certainly falls into the category of a παιγνία. It was also called *Ephebike* or *Epikoinos*, Pollux tells us—the first because it was a game rather for young men than for children, the second because a moderately large number of players took part in it.

That the game should have originated in Asia Minor seems still more probable in view of the fact that the date on grounds of style of this relief is shortly before the year 510 B.C., when the Ionian artistic and other influences originally imported to Attica by Peisistratus were the ruling fashion. This Ionian predominance in fashion would have sanctioned the adoption of a game from Sparta which was already known to the Ionian elements of the population who had come over to Athens as artists, students, and athletes.

As a work of art this relief is one of the most remarkable and beautiful of the archaic period ever found in Greece. The darkness of the background that is evident in the photograph is due to the fact that the original crimson colouring is admirably preserved. The elegance, perhaps at times slightly exaggerated, of the

[1] I am indebted to Professor J. L. Myres for this suggestion.

[2] See M. N. Tod in the *Annual of the British School at Athens*, vol. x, pp. 43 ff.

[3] See Herodotus, i. 94.

figures and the variety of their attitudes show at once the vigour and the capacity for experiment which was so characteristic of the Ionian art of Attica at this period. The back view and the foreshortened drawing of the feet of the captain of the team on the right provide us with one of the earliest examples in sculpture of this artistic initiative which was so characteristic of the period.

It may be objected that Pollux was hardly in a position to know anything about the games that had been played in Athens in the days of Peisistratus. But it must be remembered that games die hard : the urchins of Rome still play the games that were in vogue in Imperial times. There was, further, something in the nature of a revival of the old university life of Athens

FIG. 2.—THE ANCIENT ATHENIAN EQUIVALENT OF HOCKEY.

at the time that Pollux was there ; even if *Episkyros* had not been revived as a game, there would probably have been men who knew well enough what the game was.

The relief which shows the so-called "Hockey-players" involves no serious problem of interpretation beyond that of the precise name and nature of the game, if one can be found. The scene is simple and straightforward. Two naked athletes in the centre of the field bend down, each holding a hooked stick, which, to judge from the proportions it bears to the bodies, must have been some two and a half feet in length. Behind these central figures on each side are two other players standing in attitudes of rest, all except one holding similar sticks. The one exception holds his hands in an attitude of one holding a wand, but there are no traces of either a metal fixture or of a painted wand, and it is difficult to see how, if painted, it could have been rendered, since the surface of the marble is broken by the two projecting arms of the two figures so that it would be impossible to paint a straight line upon it.

The attitude in detail of the two central players is curious. Each holds his stick by a grip well up the shaft and not at the end. The player on the right holds it in his right hand and places his left hand almost, but not quite, upon the butt of the stick. The other player uses his hands in the same way, but with the right hand as the playing hand. The ball lies between the two sticks as though in position for a "bully."

The game, to judge from the evidence of the relief alone, is one for two players and not for a team. The players at the sides seem to be spectators waiting their turn. Perhaps there were two teams, each consisting of three players, who played in individual combat, the game being thus decided on points.

The name of the game has been fixed, almost with certainty, by the Greek archæologist M. Oekonomos,[1] of Athens. He finds, in a passage in Plutarch,[2] a reference describing a statue of the orator Isocrates. The statue represented him as a boy, was of bronze and stood on the Acropolis at Athens in an enclosure called the "Sphæristra of the Arrhephoroi." The Arrhephoroi, we know, were the two attendants who acted as priestesses or officials in the Panathenaic and other processions. Their dwelling is usually identified

[1] In the official Greek journal Δελτίον Ἀρχαιολογικόν, 1922, pp. 56–9.

[2] *Lives of the Ten Orators*, ch. 4.

on the north side of the Acropolis near a steep postern stairway. The "Sphairistra," which can only mean a "court for ball games," must have been near at hand. Plutarch describes the statue as κερητίζων, a word which has been rejected by the editors of the text because no meaning could be found for it: its manuscript authority, nevertheless, is excellent.[1] It has been emended to read κελητίζων, which has the straightforward meaning of "riding a horse," the statue thus being equestrian. M. Oekonomos, however, retains the earlier reading κερητίζων and, from the connection of the word with κεράς, "a horn," he derives the word which gives us the name of the game—a "game played with horned sticks," or, if you like, the "game of hook." It is noteworthy in this connection that the place in which the statue of Isocrates stood was a "court for ball games," and, further, that the attitude of the central players on our relief is that of hooking and not of striking, as in hockey.

The style of this relief is very greatly different from that of the first. It is by an inferior artist who was not successful at unusual attitudes. He has failed to render the grace and agility of the bending figures, though he is more successful with the standing. The figure on the extreme right, however, is clumsily outlined. From a comparison of the faces of the figures—the most conventional part about them—with coins of Athens bearing the features of Athena of the early fifth century, it seems most probable that the relief belongs to a period about 495 B.C.

Filter-Passers

By R. J. V. Pulvertaft, B.A.

THE great fascination of science and discovery lies in the search for that far-off shore where is attained the final and indivisible truth—the last, remotest star, the western continent, or the tiniest morsel of life itself. It seemed to the pioneers who first sighted the bacteria—those minute fungi, distant cousins of the breakfast mushroom—that they had attained their goal, and that Life could not live in narrower confines. Yet to-day we hear of living creatures far smaller than most bacteria, but of even greater importance in the havoc they work to the human race. To this group of living morsels has been given the name of "Filter-passers," and, although they have baffled research from the time of Pasteur to the present day, it would seem that now at last we are beginning to understand more about them.

Let us consider the diseases believed to be caused by them first, and then discuss the methods used to get into touch with them. First, and most important in its universality, we have influenza; small-pox, hydrophobia, scarlet fever, and measles are among the commonest of diseases throughout the world of man, and are attributed to the same group of organisms. Foot and mouth disease is one representative of the damage they do to the animal world, and distemper in dogs another. Even the plant world suffers from them. For instance, mosaic disease in tobacco plants ruins many crops yearly. We notice that all these diseases are very infectious—infinitely more so, for example, than the bacterial disease typhoid fever, which can only be contracted by eating infected material or injecting bacteria. We get the impression that there must be a deadly mist arising from an influenza patient—that the tiny creatures which cause it must float like clouds of smoke through the air. That fact alone would serve to incline us to the belief that the fatal organism, whatever it be, is very tiny.

The Size of Filter-passers

Its size is further emphasised by the property from which it has derived its name—the power of passing through a filter. The filters used by the careful housewife to purify her water supply, and by the bacteriologist to rid the fluids, with which he works, of bacteria, are of two kinds. The Berkefeld filter is made by compressing an earth which consists of the flinty skeleton of a microscopic plant known as a diatom—an earth which is also used as a knife polisher and a tooth-powder. The solid mass formed by this compression has little pores in it, and we can readily believe, from the nature of it, that these pores will be of various sizes. It has been estimated that particles as large as a five-thousandth part of a millimetre—·2 μ in the language of the bacteriologist—can pass through the filter in some instances. The second kind of filter is the Chamberland—it is made of unglazed porcelain, and has much smaller pores. Perhaps we should not be far wrong in assuming that any particle which passed through it must be smaller than a fiftieth part of a μ.

Every filter-passer can pass through a Berkefeld filter, some can negotiate a Chamberland, and one has been described—the organism responsible for mosaic disease in tobacco plants—which is even said to be able to diffuse through gelatine. It seems, however, in a high degree unlikely that particles so minute as to diffuse in that way can really be alive at all.

But even a particle a five-thousandth part of a millimetre in size is far too small for us to imagine. The tiniest drop of human blood contains seven million red blood cells, and each of these is more than thirty times

[1] It occurs also in the lexicographer, Hesychius.

as big as the biggest filter-passer. We can, however, see bodies as small as six-millionths of a millimetre by appropriate means. When we look through an ordinary microscope, we see objects as black specks on a bright background—some of the rays of light from the reflecting mirror are obstructed by the object looked at. An alternative method is to transmit the light at an angle through the liquid examined. In that case every little particle will reflect rays of light to our eye, and we will see the object as a bright speck on a dark background. It is by this method that we can see the smallest objects yet described, and it is obvious that a filter-passer is a giant compared with the particles that may be seen.

Filter-passers, then, are not too small to be seen. The trouble is that when a fluid, such as a nasal secretion from a dog with distemper, is looked at by these special means, so much is visible that it is not possible to distinguish the filter-passer from other unimportant particles.

Even a bacterium is not easy to identify if examined in a state of nature. It must first be " stained " with aniline dyes ; and the aniline dyes themselves consist of relatively large particles. Staining filter-passers has therefore not proved helpful—the particles of dye and the organisms themselves are too nearly of the same size.

In spite of these difficulties, many claims have been made that filter-passers have been both seen and identified. In some cases—notably in measles—a tiny bacterium, 2 μ in diameter, is described from America. Again, in the pneumonia of cows a bacterium is shown to pass a filter, and to be associated with the disease. We see, therefore, that at least in some instances the fact that the organism of a disease passes a filter does not show it to be of necessity other than a bacterium.

On the other hand, in distemper, influenza, and rabies, to mention only a few diseases, the objects seen do not resemble bacteria. They are tiny specks—that is all that can be said of them.

Are Filter-passers Alive ?

We must now turn to a rather important question. How do we know that these little objects are alive ? And if alive, how can we be sure that they cause the disease ? It is probable that the answers to these questions would not satisfy everyone. Bernard Shaw, in the preface to *The Doctor's Dilemma*, thinks it possible that all bacteria may be only symptoms, and not the cause, of disease. It is worth while to spend some time in the consideration of the reasons given for a belief in the life of a filter-passer, and its relation to disease.

Life is always difficult of definition. But one very significant property of living matter is its power of reproduction. It is on the establishment of that feature in filter-passers that the whole theory of their nature rests. It is not enough to say that if we filter a nasal secretion from a sick man, and then inject it into another living creature and produce similar symptoms, we have proved that there is a living organism in the filtered fluid. All bacteria produce poisons as they carry on their business of living ; these can be filtered off and will produce severe symptoms. But if, having produced symptoms, we can filter off another fluid, and produce symptoms again in this third animal, and so on many times over, we must come to the conclusion that an organism is reproducing itself on each occasion in the body of the patient. No bacterial poison could produce symptoms after dilution to many thousand times its original volume, and this dilution is involved in the process described.

Artificial Culture

Again, if we can grow the filter-passer, take a tiny morsel of the growth, and grow it again and again on suitable soil, we can prove that it is reproducing itself and is alive. Both these processes have been carried out with many filter-passers. But very special methods must be adopted to cultivate a filter-passer in a test-tube. It will only grow out of reach of the air ; only in special fluids, and only if a piece of rabbit's kidney, or another organism, be included in the tube. Volpino, an Italian scientist, has grown the filter-passer which causes cow-pox by growing a harmless bacterium with it. Noguchi, a Japanese bacteriologist, was the first to grow a filter-passer, in 1913 —the organism of infantile paralysis. The influenza filter-passer has been grown in America, in England, and in South Africa, and at one time or another many other successful attempts have been reported. There have been many failures too. Even Polar bears cannot rear their young in captivity ; the leprosy bacillus has never been grown, and so we cannot be surprised if filter-passers, too, do not seem to love unnatural surroundings. They wilt and die, like rare orchids.

Do Filter-passers Cause Diseases ?

When Koch, the great discoverer of the tubercle bacillus and the father of modern bacteriology, first described his success, he laid down the law that in order to establish a definite relationship between an organism and a disease, the organism must be discovered in the body of an animal into which it has been injected, and which has suffered, as a result, from the disease. This has proved very difficult in many bacterial diseases. Leprosy has never been successfully transmitted in this way. It is doubtful whether scarlet fever, in spite of many attempts with human

beings, has been transmitted. Even influenza, in spite of the American claims which have lately been widely published, is still on the doubtful list. Many believe that a bacterium called after Pfeiffer is the real culprit. But filter-passers offer a very special problem, since in two instances—in small-pox and in hydrophobia—instead of the tiny filter-passer, much larger bodies, known as the Guarnieri bodies and the Negri bodies respectively, are found in the organs of the dead animal after injection of a filter-passer. They are too big to pass a filter; we shall return to them later, and see how they may be related to the filter-passer.

For the moment we must remember that bacteria are not the only creatures whose presence in the human body brings disease and death. The protozoa form another group, the first and tiniest animals, as the bacteria are the first and tiniest plants. Malaria is a type of a protozoal disease. These little animals have a life-history; unlike bacteria, which exist only as spores or adults, we can parallel in them Shakespeare's seven ages in man. And it is possible that some filter-passers are protozoa, not bacteria. Many protozoa can, at some stage in their history, pass through a filter. It has been stated—and, as in the case of nearly every statement which can be made on this difficult question, it has been denied—that the protozoon found in sleeping sickness can pass a filter during some of its stages. And when we come to examine the reports of those who claim to have grown a filter-passer in a test-tube, we find that they are not identical. In some instances, as in infantile paralysis, the familiar tiny, nameless speck is seen. In others—notably in Noguchi's description—an oval object, with a central body or nucleus, was seen. Such a description is unlike a bacterium, but very like a protozoon. And then we find the Negri body—a group of tiny specks in a surrounding envelope—in the brains of dogs dead of hydrophobia. That may be another stage in the filter-passer's history. And another fact is very suggestive. How is it that by giving a man cow-pox—a distinct disease as far as symptoms go—we can excuse him from the necessity of having small-pox? Such a state of affairs is unique in medicine. The suggested answer is that cow-pox is caused by one stage of a protozoon; small-pox by another. Variation in the stages which protozoa achieve in different animals is well known—even in malaria the parasite is in a different stage in the mosquito and in man.

Some Special Filter-passers

It is pleasant to relate that filter-passers are not always our enemies. A remarkable theory is put forward by D'Herelle. He believes that he has found a filter-passer which lives, like a parasite, on bacteria. He calls it the Bacteriophage, or Bacterium-eater. Space will not permit of a full description of this last example of the law that "Big fleas have little fleas upon their backs to bite 'em," but it has obviously a very important bearing on the question of immunity to disease.

To make our survey, brief though it is, more complete, we must mention the question of malignant growths such as cancer. It has been stated that warts are caused by filter-passers, and warts bear considerable resemblances, from the pathologist's point of view, to cancers. It is well established that a form of cancer in birds and dogs is related to filter-passers. Many years ago large bodies called "Russell's corpuscles"—a harmonious phrase—were described in malignant tumours, and might be compared to the Negri bodies of hydrophobia. But, obscure though the cancer problem is, it is not probable that the solution will come from a study of filter-passers—and "Russell's corpuscles" have long been discredited.

It will be interesting to await the results of the present concentrated attack on the question of distemper in dogs, and its relation to influenza in man. Perhaps in a very short while we may see this whole question on a far more secure basis than it is at present.

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Modern Industries

I. CEMENT MANUFACTURE ALONG THE HUMBER

By R. C. Skyring Walters, B.Sc., Assoc.M.Inst.C.E.

THE object of this paper is to describe the cement-making industry in the North Lincolnshire and South Yorkshire coasts bordering on the Humber estuary.

The raw materials required for the manufacture of cement are those containing 75 to 78 per cent. of calcium carbonate (obtained from certain chalks or limestones) and the balance (25 to 22 per cent.) of silica, alumina, and iron (a constituent of shales, clays, or muds), and the most successful works are those which are situated near both these materials and which can easily obtain good supplies

of coal or coke, with adequate transport facilities for sending away the finished product from the works.

The usual method is to burn chalk containing the necessary calcium carbonate with the clay in cylindrical kilns, upwards of 200 ft. long, which slowly revolve. The kilns are *inclined*, enabling the mixture of chalk and clay, which is well pulverised and made into a liquid paste called "slurry," to travel slowly down the kiln. At the lower end, a blast of coal-dust is blown in, which immediately catches fire and burns the on-coming slurry to hard grey nodules of varying sizes up to a man's fist. The nodules, if suitably burned, are ground and reground to a powder so fine that, in order to qualify for the British Standard specification, 86 per cent. of it must pass a sieve with 32,400 meshes to the square inch. In this state it is the finished Portland cement. At Barton the cement is ground so that approximately 97 per cent. passes this sieve. The whole process is, at the present day, carried out in the most scientific manner; several chemists are employed in a large establishment. This ensures the product being not only good, but *invariably* good. In the old days, when the manufacture was carried out by rule of thumb, the resulting cement was very unreliable.

The silica and alumina in the clay combine with the lime in the chalk. The compound of the greatest cementitious value is believed to be tri-calcium silicate; therefore, if the percentage of calcium carbonate gets too low, too much bi-calcium silicate is formed; whereas if it gets too high, there is too much free or loosely combined lime present and the cement will be unsound. The general rule is that the higher the percentage of lime, the higher the strength of the cement; but such factors as the fineness to which the raw materials are ground and the correct temperature of the kilns are most important. In a kiln one attempts to arrive at what is called incipient fusion.

Modern methods of cement manufacture therefore ensure a cement of uniform quality from a particular establishment and have enormously increased the use of all kinds of work in reinforced concrete, such as bridges, retaining-wells, reservoirs, factories, warehouses, floors, and such things as seats, sign-posts, signal-posts, which it is now becoming very common to make of this material.

The Humber-side possesses all the natural advantages for manufacturing a first-rate Portland cement. The calcium carbonate is there on both sides of the river, in cliffs, some 200 to 300 ft. high, which constitute the high ground known as the Lincolnshire and Yorkshire Wolds. They contain some of the largest chalk-quarries in the country. The necessary clay lies at the foot of these cliffs in the form of river-mud, probably deposited

FIG. 1.—HESSLE QUARRY.
Output of chalk, with two diggers operated by five men in all, totals 5,000 to 6,000 tons per week.

by the Humber. (It is scarcely probable that any of this should be of glacial origin, that is, deposited by the melting of the glaciers that are known to have once covered these regions.)

The necessary coal is brought by the cheapest of all methods of transport, water, from the neighbouring Yorkshire Coal-field to the works situated by the water-side and, lastly, the finished product can be readily sent away from the works or exported from the neighbouring ports of Hull, Immingham, and Grimsby.

Very few fossils have been found in the immense pits excavated, but a few ammonites, fish-teeth, and echinoids, popularly called "fossil-mushrooms," have been unearthed. The chalk is won by pick and shovel; holes are "jumped" and blasting is resorted to, charges being inserted at or near the floor of the quarry; and these, when exploded, generally bring down a portion of the whole of the vertical cliff face. Occasionally men work, where it is safe, on ledges half-way up or near the top. In the quarry illustrated in Fig. 1, where mechanical diggers are

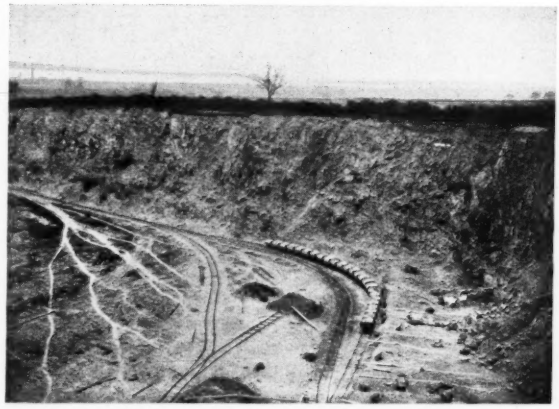

FIG. 2.—THE NEW CHALK QUARRY NEAR BARTON-UPON-HUMBER. Showing method of working in foreground, and the Cement Works and River Humber in the background.

in use, 5,000 to 6,000 tons of chalk are dug per week, the men actually employed on these being five in number.

The chalk is loaded into trucks, as shown in Fig. 2, which are taken by a steam locomotive to the works just discernible on the left-hand side of the picture, which shows also the Yorkshire coast-line on the other side of the Humber. The flint is picked out into heaps, also shown in the photograph, suitably loaded into trucks and taken away for road-metal.

The floor of this quarry has the great advantage of being dry, as it is slightly above the low-lying ground in the vicinity of the Humber. This enables the quarries to be worked in comfort and saves the great expense of pumping which in some places is needed. The clay is dug in a large but shallow pit in the low-lying ground between the quarry and the works as shown in Fig. 2.

On the Yorkshire or northern side of the estuary is perhaps one of the most recent establishments laid down in the country for the manufacture of cement. Here the chalk is dug three miles away inland, where there has been erected a plant to crush it and make it into slurry. In this form it travels through some three miles of pipes to the works situated on the Humber side. It is conveniently placed in proximity to clay deposits, similar to those that occur on the South Ferriby side, and it is well situated as regards transport facilities.

NOTE.—The writer wishes to thank Mr. A. N. Earle for much of the information embodied in this article.

Reviews of Books

NEW LIGHT ON THE WANDERINGS OF THE CELTS

The Bronze Age and the Celtic World. By HAROLD PEAKE, F.S.A. (Benn Bros., 42*s*.)

The later stages of the prehistoric period—Neolithic, Bronze, and Iron—afford no sensational evidence of man's past, such as we are accustomed to expect from discoveries of the Palæolithic or Early Stone Age. Yet the restricted attention which these periods receive is due to no lack of interest in the subject-matter. It is to be attributed rather to the fact that, with few notable exceptions, writers on the subject, if they have appealed to a public wider than the specialists, have been content to give a general view of the culture of each period as a whole, but have not dealt on broad lines with the more general problems of racial history which underlie the study of prehistoric culture and give to archæological investigation both its bearing and its perspective. It is an outstanding merit of Mr. Peake's study of the Celtic problem that, while the main foundation upon which the whole structure of his argument rests is of a highly technical character, its detailed discussion is not allowed to assume disproportionate prominence and its relation to broader problems is never forgotten. In fact Mr. Peake's lucidity and breadth of treatment are such that even those unversed in the technicalities of the subject may follow his argument and earn both profit and enjoyment from their reading of the book, even though they may fail to appreciate the immense amount of research and the imaginative handling of detailed evidence which have gone to its making.

The Celtic problem has at one time or another attracted much attention from both archæologists and philologists. The Celtic language presents peculiarities in structure and vocabulary which mark it off from its sister tongues of the Aryan group, and belong to a non-Aryan language such as, possibly, the now extinct Pictish. It is spoken only by peoples living on the north-western fringe of Europe—Wales, Scotland, Ireland, and Brittany, and, up till comparatively recently, Cornwall and the Isle of Man. The people who speak it belong to the short brunette type called by anthropologists the Mediterranean race. These people are popularly known, particularly to

the daily Press, as the Celts, but it is an important factor in the problem that in classical times the Celts were described as tall, fair, and light or blue-eyed. Further, it is known from the accounts of classical writers that the Celtic language in the century immediately preceding the Christian Era had a far wider distribution than it has to-day, and was the language of all Europe west of the Rhine and north of the Pyrenees and the southern slope of the Alps, including the Alpine zone of Central Europe as far as a line Agram–Cracow and, possibly, at one time farther east. The Galatians of Asia Minor, to whom the Epistle of St. Paul was addressed, were an offshoot of the Celtic race. The problem, then, to which Mr. Peake has addressed himself in the light of anthropological, archæological, and philological evidence is the origin of these peoples and the date of their intrusion into those areas in which they were found some two thousand years ago. Mr. Peake accepts the view that, on the evidence of our classical authorities, the Celts were tall and fair and that they are to be identified with what is now known as the Nordic race. This race, with the broad-headed Alpine and the dark, long-headed Mediterranean type, made up the population of Europe at the dawn of the Neolithic or later Stone Age Period. The Alpine race came into Europe from Asia, while the Mediterranean race had descended from one or possibly more of the types of man of the last phase of the Palæolithic Age. The Nordic race remains to be accounted for. Mr. Peake suggests a descent from Solutrean Man—the man who lived in the last period but one of the full palæolithic period, when climatic conditions produced broad open plains, suited to the life of nomad hunters—a mode of life very different from that of the comparatively sedentary Aurignacian and Magdalenian cave man who preceded and followed Solutrian Man. At the beginning of the Magdalenian period a change in climate is accompanied by the disappearance of the Solutrians. Mr. Peake suggests that they withdrew eastward, and on the steppes east of the Dnieper, perhaps ranging as far as Turkestan, gave rise to the culture of the Kurgans or burial mounds of Southern Russia—a culture of which in this connection the chief interest is that it is that of a race of nomad hunters. In these people Mr. Peake finds the beginnings of the Nordic race, and interprets the somewhat puzzling archæological evidence of this area and period as indicating a series of expansions or migrations which led them to overthrow neighbouring civilisations, such as that of Tripolje in South Russia and Anau in Turkestan, and, finally, about 2200 B.C., to occupy the Hungarian plain. Another branch of this migratory movement reached Mesopotamia and ultimately was responsible for the Cassite domination in that area about 1700 B.C., and again another brought about the destruction of the second of the six cities found on the site of Hissarlik (Troy).

Before turning to the later wanderings of this people, it is desirable to indicate a little more in detail the kind of evidence upon which Mr. Peake's inferences are based. It is briefly that of type and distribution. A particular class of evidence is taken, as Mr. Peake has taken the leaf-shaped sword of the Bronze Age, and the relation of the various types to one another is studied and classified in a series of development. The distribution of the types is then plotted on the map. This method of study, of which the possibilities are only just beginning to be appreciated, has already proved most fruitful. No better example of its merit need be sought than the results it has yielded to Mr. Peake. The chapter on the commerce and trade routes of the Neolithic and Bronze Ages will repay close attention from this point of view. In the case of the leaf-shaped sword, so called from the shape of the blade, which is classified into seven types, the author is able to show that it developed from the Mediterranean bronze dagger in the Hungarian plain, whence it spread over the greater part of Europe. One of two found in Egypt is engraved with the name of Seti II, thus giving a definite date for its type. Treating it as the characteristic weapon of the Nordics, Mr. Peake infers from its distribution the wanderings of this race, dating them by type, and shows how they advanced against the less aggressive agricultural races, as, for instance, the Alpine peoples of the Central European mountain zone, and established themselves as overlords. These leaf-shaped swords have been found in Greece, Italy, Central Europe, the Baltic, Gaul, Britain, and Ireland. In each case Mr. Peake's theory of the intrusion of a wandering adventurous element seems to fit in with what we know of the prehistory and early history of these various parts of Europe, and serves in some cases, as in Greece and Italy, to afford valuable assistance in elucidating their special problems.

In the case of Britain, Mr. Peake concludes that the course of events was rather different. An early infiltration of these races was followed by a later and extensive immigration. The association in this country of bronze agricultural implements with a late type of leaf-shaped sword, points, he thinks, to a wholesale exodus of overlords and subject population from Central Europe. This exodus was probably caused by a later wave of Nordics from the Hungarian plain who had acquired the use of iron, possibly from the Caucasus. In any case, whatever may have been the cause of the migration, the Nordics would appear to have imposed their own language on the population of Britain so effectually as practically to have caused all but a few traces of the earlier tongue to disappear.

Mr. Peake's view thus agrees in the main with the conclusion of Sir John Rhys, at which he arrived on philological grounds, that the British Celts represent two separate waves of migration from Central Europe.

It has not been possible to deal with Mr. Peake's system of dating, nor with his examination of the linguistic evidence and of the Aryan problem, important as these are in support of his argument, nor has it been possible to do full justice to his handling of the innumerable controversial questions ranging from earliest Palæolithic times down to the Iron Age, upon which he touches. As an exposition of the broader problems of prehistoric archæology, Mr. Peake's book stands alone. *The Bronze Age and the Celtic World* is, indeed, a work upon which the author is to be congratulated.

E. N. FALLAIZE.

The Measurement of Emotion. By W. WHATELY SMITH, M.A. (Kegan Paul, 10*s.* 6*d.*)

It has been known for some time that the resistance offered by the human skin to the passage of a faint electric current varies sharply with changes within the body, and in particular with the presence or absence of an emotional state; this latter concurrence is known as the "psycho-galvanic reflex," and some rather distorted accounts of it have appeared in the daily Press.

In order to excite an emotional reaction for the purpose of studying it, a very convenient method is the word association reaction of Dr. Carl Jung, in which a number of words are called out, one by one, to the subject of the experiment, who is required to answer with the first word that comes into his head. Some idea of the emotion, if any, excited by the word can be obtained by consideration of the character of the answer and of the rapidity or delay in making it. Further information is obtained by measuring the disturbance produced in the galvanometric circuit in which the object is included, by calling out the word.

Mr. Whately Smith finds good reason for concluding that the electric disturbance is proportional to the intensity of the emotion, and by combining the very delicate and measurable psycho-galvanic reflex with the word association reaction (for the first time systematically and over a very large number of observations), he has obtained some extremely important results. In the first place he has made a contribution to pure psychology in throwing new light upon the nature of "affective tone" (the undifferentiated state behind the emotions that is elaborated into "pleasant" or "unpleasant" feeling); in the second place the findings made by the exact and quantitative galvanometric method have refined and made more reliable the word association reaction as an instrument of diagnosis—a matter of considerable importance to the practising psychologist. In the last chapter the author formulates a theory of the nature of emotion (or, more exactly, of "affective tone") that he has built upon the experimental results.

The theory postulates that we live continually in a state of inhibition, that is to say, our immediate impulses to action, which are naturally for the most part unconscious, tend to be subjected to a greater or lesser degree of repression or postponement. According to the author, an increase of this repression gives rise to a negative affective tone, and this, if we become conscious of it, to a feeling of discomfort. A decrease in inhibition gives rise similiarly to a positive affective tone and a feeling of "pleasure." From this we may deduce the somewhat melancholy conclusion that while there is scarcely a limit to pain and discomfort, happiness has a definite term—could it be reached—in absolute freedom. In connection with this dependence of pleasurable feeling tone upon freedom from constraint and conflict, it is perhaps worth noting the strong pleasurable feeling experienced in the typical dream of flying—a dream to which the Freudian school of psychology has given a somewhat narrow sexual interpretation.

Mr. Whately Smith's theory has a close parallel in many of the normal physiological processes of the body, which under ordinary conditions are kept stable by the balance of two opposing influences; and the theory is completely congruous with the conception of man's psychological evolution along the lines indicated by MacDougal[1]; and with Freud's theory of man's development from the "Pleasure-pain Principle" to the "Reality Principle."

Although *The Measurement of Emotion* is a book primarily for the specialist, yet it should prove of great value to anyone interested in psychology and familiar with the current theories; while the precision of the author's methods, and the ingenious system of checking and controlling the results, form an object-lesson in psychological research and a contrast to the somewhat tenuous fabric upon which not a few modern psychological theories have been constructed.

F. A. HAMPTON.

Protein Therapy and Non-specific Resistance. By W. F. PETERSEN, M.D., with an Introduction by J. L. MILLER, M.D. (New York: The Macmillan Co., 21*s.*)

Twenty years ago a textbook of medicine was apt to give forty or more drugs as useful in one particular ailment. To-day, it rarely gives more than two or three; a multiplicity of "curative" prescriptions always argues that all are futile to effect a cure or incapable of modifying a natural cure. This tendency arises in part from the recognition of a very few drugs which appear, quite definitely, to have a specific effect in particular conditions. Many of these drugs were used from antiquity—for example, zinc compounds are used to-day in certain eye conditions, and were used in ancient Egypt with equal success and equal ignorance as to the theoretical basis of their peculiar virtue. Some few are the result of laborious laboratory research; others, such as quinine and digitalis, were country simples or native remedies before they were dignified by elevation to the Pharmacopœia. In all, the specific drugs—those that have a selective effect in curing one particular condition—are very few in number. But their existence has influenced medical opinion; the search is always for a means of countering each individual foe with its single and appropriate weapon. If anyone needs further proof of this, let him compare the size of a hospital pharmacopœia—a book for the vest pocket and practical purposes—with the British Pharmacopœia—a book for the fireside, if not for the fire!

But the greatest single influence in this direction has come from the important work which Sir Almroth Wright and his numberless followers have done in establishing the principle of Vaccine Therapy. The method and its theoretical basis may be briefly outlined. Suppose that a bacterium has established itself in the nose, and we suffer, consequently, from colds in the head. Some of these bacteria are taken, and grown in a medium which is found suitable; they are then killed, by heat or chemical means, and injected into the arm. Whereas, before, the infection, localised in one small part of the body, did not

[1] *Social Psychology.* (Methuen & Co., Ltd.)

call forth the armed hosts of the body's mechanism to defeat it, this artificial injection is capable of so doing, and we cease—if we are fortunate—to suffer from colds in the head.

The essential feature of this method was that success was believed to depend on the injection of the corpses of the particular bacterium causing the disease. More than that—although we might have a stock of bacteria in hand identical to all appearances with those in the nose, they might fail, while the actual bacteria taken as we have described would succeed.

This law of specificity seems universal in the mechanism of life. In the process of digestion, as in a hundred other vital processes, numerous "enzymes" are employed. These are mysterious substances, capable of bringing about great chemical changes, but strictly confined each to its own task. That is the reason why a new-born babe cannot digest starch, however much the patent foods for infant feeding may proffer it, for it lacks the specific substance which turns starch into sugar.

In considering Dr. Petersen's masterly exposition of an attitude towards disease and a method of treatment differing in many respects from these strictly specific conceptions, it ought to be said at the outset that it implies no contradiction of Sir Almroth Wright's views. Indeed, Sir Almroth Wright is almost the only English name quoted in a remarkably complete bibliography, in connection with the evolution of the modern non-specific method. This method is only of some six years' birth ; it is widely known in Germany and America, somewhat less so in France and Italy, and very little considered as yet in this country. It is an amplification rather than a refutation of the specific theory of resistance to disease.

In the process of this new therapy, a large variety of substances are injected into the skin or blood-stream. A casual glance at a list of them might lead to a fear that the doctor had mistaken the kitchen cupboard for the medicine chest, for yeast, milk, eggs, cheese, and gelatin feature prominently. But there is a common basis for their injection ; they all contain a complex chemical compound known as Protein. It has long been known that when protein is injected into the blood-stream, enzymes, to which we have alluded above, are produced which digest or destroy it. The injection of protein is always injurious in itself, since it sends up the temperature and causes many disagreeable symptoms. Bacteria themselves consist of protein ; when they die they break up into poisonous substances, and in their life they excrete poisons derived from proteins, and the body in which they live produces similar poisons on account of their presence. One of the lines on which the body counteracts their evil influences is by the production of enzymes which destroy protein and the substances derived from it.

So when milk or egg is injected, it is argued that an immense number of enzymes are produced, capable not only of splitting up milk or egg, but also bacteria and their products. At the same time we get the temperature rise and the other symptoms, but these are a small price to pay for the destruction of the bacteria.

We might ask what advantage it is to inject the proteins of milk, when we might inject the protein of the bacterium itself. If it be proved that better results follow the milk injection, the question is of only theoretical interest. Moreover, the method is applicable, according to the author, in cases where the bacterium is unknown. But the answer to the question appears to be that, whereas on injecting the bacterium only these enzymes, which digest the bacterium and its products, are produced by the body, the milk injection is followed by the production, among others, of enzymes which digest the poisonous products of the body's own abnormal workings. But here we are admittedly on very uncertain ground, and further investigation is required.

Such is the method and its theoretical basis. There is no space here for a review of the results of experience which Dr. Petersen brings together in this book. Some criticisms at once occur to us—for example, on p. 156, a death-rate of 15 per cent. is noted in typhoid fever when treated on these lines, and in contemporary textbooks of medicine a mortality of from 5 to 20 per cent. is quoted as normal with conventional treatment. In fairness it should be added that on p. 158, a series of 350 cases shows a mortality of only ½ per cent. ; but as a Roland to his Oliver we can quote figures from one ward in a London hospital, where conventional treatment shows a mortality of 0 per cent. in 57 cases. Again, the most remarkable cures are reported in the case of chronic joint affections, which are notoriously the chosen sphere of every new therapeutic method from faith-healing to bone-setting—they appear to yield to a limitless variety of treatment for a time.

It should be mentioned, also, that the injection of protein is only one side of a scheme of treatment which aims throughout at producing a general reaction to a disease, and which covers a large field, including X-ray treatment and the old-fashioned mustard blister.

But, when every possible criticism has been brought forward and due allowance made for the enthusiasm of a prominent exponent of the method, this book remains a most valuable contribution to our knowledge of the problems of disease and immunity, and as a book of reference should prove invaluable to the specialist. And if the value of the method be established, medicine would be rid of much of that atmosphere of pessimism and mere academic classification which broods over it to-day.

R. J. V. P.

General Astronomy. By H. Spencer Jones, M.A., B.Sc. (Edward Arnold & Co., 21s.)

The Chief Assistant at the Royal Observatory, Greenwich, has succeeded in writing the best introduction to astronomy in English. There has been a need for such a book, for we have endured too long successive editions of the great textbooks of the past with their lack of freshness and, despite the labours of revising editors, their complement of error. Now comes this book giving a reader a tolerably complete view of the present state of astronomy, an account at once lucid and scientific from which the higher mathematics have been entirely excluded.

It should appeal to the amateur no less than to the student.

The author starts with a discussion of the celestial sphere, and then describes the earth, the moon, and the sun. Among the subjects considered may be mentioned the size and motions of these bodies, their distances from each other, the occurrence of eclipses and occultations, and the phenomena of sunspots. Then follow two chapters describing the latest astronomical instruments and methods of making observations. Next comes an account of planetary motion and a description of the planets and their moons. Subsequent chapters are entitled "Comets and Meteors," "The Stars," "Double and Variable Stars," and "The Stellar Universe." The plates which adorn the book contain a very representative set of astronomical photographs. The author has been in a position to choose them carefully, and he has seen to it that they have been accurately reproduced. A. S. R.

Synthetic Colouring Matters. Vat Colours. By J. F. THORPE, C.B.E., D.Sc., F.R.S., and C. K. INGOLD, D.Sc. (Longmans, Green & Co., 16*s.*)

Indigo, derivatives of indigo and of the substance anthraquinone are the most important members of the series of colouring matters known as vat-dyestuffs. These pigments are insoluble in water and many other solvents, but by a slight chemical change may be made soluble and then incorporated in the fibres of fabrics. On exposure to the air the original insoluble pigment is regenerated *in* the fibre, in which it becomes fixed exceedingly firmly. Dyes produced by this method—vat colours—are the fastest, most brilliant, and most valuable of all colouring matters. Professor Thorpe and his colleague, Dr. Ingold, have made a careful and documented compilation of the principal properties of, and processes relating to, these dyes, writing, as they are qualified to do, both from the "theoretical" and the "practical" point of view. It is a book invaluable to the organic chemist, and is a worthy member of Sir Edward Thorpe's *Monographs on Industrial Chemistry*. The publishers, too, are to be thanked for the general excellence and accuracy of the printing (the misprints we have noticed do not confuse), and for the low price at which a book for specialists of nearly five hundred pages is offered for sale.

Practical Chemistry. By LYMAN C. NEWELL, Ph.D. (G. G. Harrap & Co., Ltd., 6*s.*)

An American book which is not a "Practical Chemistry" as we understand the term, but a "first-year" theoretical chemistry of an elementary kind, with the usual facts clearly explained and the usual processes well illustrated. The custom of American textbooks of chemistry of having innumerable photographs of everything described is not departed from.

Introduction to the Plant Life of the Oxford District. I—General Review. By A. H. CHURCH, M.A., F.R.S. (Oxford University Press, 3*s.* 6*d.*)

The latest of Dr. Church's Botanical Memoirs (No. 13) is more popular in appeal than its predecessors. Its one hundred and thirty-five pages contain chapters on the physical features of the Oxford district, on its primary woodland, its subordinate and herbaceous flora, the presence of the hand of man, and on artificial plant-formations. Most of the book can be read and enjoyed by all who, even though lacking an intimate knowledge of botany, love the countryside which is described. There are fifteen large photographs of wood and copse and stream illustrating the flora of fast-disappearing districts in the neighbourhood of Oxford. The book is good all through, full of information of many kinds, and is worthy of a botanist who knows thoroughly the district described. It is of immediate interest to Oxonians and, as a record of existing things, should be valuable in fifty or a hundred years' time.

Common Science. By CARLETON W. WASHBURNE. (G. Bell & Sons, Ltd., 4*s.* 6*d.*)

A collection of about two thousand questions asked by children forms the foundation on which this book is built. Rather than decide what it is that children ought to know, or what knowledge could best be fitted into some educational theory, an attempt was made to find out what children wanted to know. The obvious way to discover this was to let them ask questions.

The questions collected were asked by several hundred children in the upper classes of an American elementary school over a period of a year and a half. The questions gave a very fair indication of the parts of science in which children are most interested. Physics in a simple form came first; astronomy next; chemistry, geology, and such parts of physical geography as deal with weather, volcanoes, and earthquakes came third; biology with physiology and hygiene made a close fourth; but nature study, in the ordinary school sense of the term, suggested very few questions. Not all, however, are answered in this book. Questions relating to descriptive astronomy and geology have been omitted, and those relating to biology have not been stressed. The book, indeed, deals principally with physical and chemical principles. Within its limits it is excellent. The information is accurate and so presented that school boys and girls may be entertained as well as informed. The book is well illustrated by photographs of boys and girls doing the large number of experiments described in the text. It should make a good present for any boy or girl who is developing an interest in physical science and who wants to know such things as why the Leaning Tower of Pisa doesn't fall over, how things stick to one another, why it is preferable to face forward when alighting from a moving 'bus, and what makes the ocean look green in some places and blue in others. The chapter on Electricity is specially clear and well illustrated. The author has his pupils repairing blown fuses, making arc-lamps, electro-plating, and sending messages with a cigar-box telegraph.

The book just buzzes with information on all the elementary scientific matters that crop up in the course of everyday life. There must be few whom it cannot interest. Teachers who require to give elementary scien-

tific talks and demonstrations of a popular kind should see it.

The Mathematical Theory of Relativity. By A. S. Eddington, M.A., F.R.S. (Cambridge University Press, 20*s.*)

This is a systematic and comprehensive treatise on the mathematical theory of relativity, written for physicists possessing a strong mathematical equipment who have already obtained a general acquaintance with the theory in a less technical form such as from the author's previous book, *Space, Time and Gravitation.* It formulates mathematically the new conception of the world described in the other work, and follows out the consequences to the fullest extent. It should take its place as the standard mathematical work in English on relativity.

A. S. R.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

Primitive Ordeal and Modern Law. By H. Goitein. (George Allen & Unwin, Ltd., 10*s.* 6*d.*)

The Religion of Science. By Prof. William Hamilton Wood. (Macmillan & Co., Ltd., 6*s.*)

Supplying Britain's Meat. By George E. Putnam, B.Litt. (George G. Harrap & Co., Ltd.)

Great and Small Things. By Sir Ray Lankester, K.C.B., F.R.S. (Methuen & Co., Ltd., 7*s.* 6*d.*)

PHILOSOPHY AND PSYCHOLOGY

Psychological Types, or The Psychology of Individuation. By C. G. Jung, M.D., etc. Translated, with an Introduction, by F. G. Baynes, M.D. (Kegan Paul, 25*s.*)

Hypnotism and Suggestion. By Louis Satow. Translated by Bernard Miall. (George Allen & Unwin, Ltd., 10*s.* 6*d.*)

Duality. A Study in the Psycho-analysis of Race. By R. N. Bradley. (George Routledge & Sons, Ltd., 6*s.* 6*d.*)

The Soul of the State, or (The Know Thyself). By Phil. Al. Phil. Vol. I. (Printed by Athanasios Papaspyrou, Athens.)

SCIENCE

Suggestions for the Prevention of the Decay of Building Stone. By J. E. Marsh, M.A., F.R.S. (Basil Blackwell, 1*s.* 6*d.*)

The Constitution of the Universe. By Louis Stromeyer, A.R.S.M. (Bangalore: Higginbothams, Ltd., Rs. 6.)

Wind and Weather. By Alexander McAdie. (Macmillan & Co., 5*s.*)

Crystallisation of Metals. By Col. N. T. Belaiew, C.B. (University of London Press, 7*s.* 6*d.*)

Our Solar System and the Stellar Universe. By Rev. Charles Whyte, LL.D., F.R.A.S. (C. Griffin & Co., Ltd., 10*s.* 6*d.*)

Geology. "Science for All" Series. By C. I. Gardiner, M.A., F.G.S. (John Murray, 3*s.* 6*d.*)

The Elementary Principles of Lighting and Photometry. By John W. T. Walsh, M.A., M.Sc., F.Inst.P. (Methuen & Co., Ltd., 10*s.* 6*d.*)

The Structure of Atoms. By Dr. Alfred Stock. Translated by S. Sugden. (Methuen & Co., Ltd., 6*s.*)

Richter's Organic Chemistry. Vol. III—Heterocyclic Compounds. Translated by E. E. Fournier d'Albe, D.Sc. (Kegan Paul, Trench, Trübner & Co., Ltd., 25*s.*)

Correspondence

RAINFALL AND CIVILISATION

To the Editor of Discovery

Sir,

With respect to Colonel Haig's very interesting article on the above, might I suggest that the movement of the earth's axis, known as "Precession," might be the cause of the shift northwards of the desert belt which he so clearly points out? This movement of the earth's axis must, of course, involve a correspondingly slight shift in the tilt of the plane of the earth's equator to the ecliptic. It thus necessarily follows that there must be a slight shift, north and south of the earth's equator, of the sun's maximum heat. The desert belts must reciprocate this shift. There is, therefore, a true scientific basis for his statements. Theoretically the desert belts ought to shift north and south under the action of Precession. Colonel Haig has shown that they do so. According to Professor Young, "At present the pole star is about $1\frac{1}{4}°$ from the pole. At the time of the star catalogue of Hipparchus it was 12° distant from it, and during the next two centuries it will approach to within about 33′, *after which it will recede.*" Therefore in two centuries from now the northern limit in the shift of the desert belts will be reached and the southern shift begin. Spain, Persia, etc., may therefore expect their rainfall to decrease very slightly during the next two centuries. After this their rainfall will increase, and it will be 25,867 years (the period of Precession) before a similar state of things returns. The Mediterranean basin, etc., have, therefore, not much more to fear on account of increased scarcity of rain. They will become fertile again as the desert belt shifts southwards in response to the Precessional movement.

Another piece of evidence of shift in this belt is that of ancient Canaan. See (*inter alia*) Num. xiii. 23, 27, and Deut. viii. 7, 8. The dates here involved fall in remarkably well with the Precessional period. From three to four thousand years ago the Near East and the Mediterranean basin could and should have had much more rain than to-day. In another four or five thousand years they will again be fertile and remain so for about fifteen thousand years; after which the drought will again be setting in.

Yours, etc.,

H. J. Allen.

Treales Vicarage,
Kirkham,
Lancs.
December 29, 1922.

To the Editor of DISCOVERY

SIR,

This highly interesting article, which has inspired a column in *The Times*, touches on a subject of such evident importance to the human race that one hopes it will not be allowed to drop without discussion.

Having read Colonel Haig's contribution with some care, it hardly seems possible that the "Cosmic" factors, adduced by him at the end, can have been satisfying to his own mind. Perhaps he has intended to be provocative. May it be permitted to comment briefly on the causes adduced to account for the (implied) drying up of the world's water?

(1) Water is locked up by glaciation, but we are supposed to be living in a period of deglaciation which has lasted some thousands of years.

(2) Vegetation has no doubt locked up a certain large amount of "capital" water, but its aqueous incomings and outgoings must strike a fairly accurate balance and its influence be more beneficent than otherwise, in that it assists the circulation of water.

Regarding other chemical action, it is difficult to see how much water can enter into fresh combinations except as a result of the assumed cooling of the earth.

(3) Water is a very stable compound by no means readily broken up into its constituent gases, and even so practically only by human contrivance.

(4) It is hard to believe that the cooling of the earth can have made itself apparent in the course of some 6,000 years. It has been suggested that the earth is not cooling, but is even getting hotter owing to the influence of its radio-active constituents.

Colonel Haig brings out one significant fact very clearly, namely that the deserts of the Northern Hemisphere have all been centres of civilisation and that their degradation from fertility to desert conditions has been extraordinarily rapid. Do we know any influence but man's on the earth that produces such results in so comparatively short a time? Another important fact brought out is that deserts, once established, tend to spread.

Yours, etc.,

FRANK W. HERBERT.

18 UPPER PHILLIMORE PLACE,
KENSINGTON, W.8.
January 3, 1923.

TESTS OF MUSICAL ABILITY

To the Editor of DISCOVERY

SIR,

May I suggest one factor in musical ability which hardly seems to me to be treated as sufficiently fundamental in Mr. Thouless's extremely interesting article, in your March number, on "New Methods of Judging Musical Ability"? I refer to the power to retain in the mind auditory images, accurate in pitch, of a note heard. The power to sing in tune clearly depends rather on this than on ability to distinguish fine intervals. I believe there are persons whose ear is sensitive to fine variations of pitch, but who find it hard to compare two notes because no really sharp auditory image of either can be called up; just as I have met persons who could match delicate shades of colour perfectly so long as both colours were before them on the table, but who were uncertain in naming colours, because they had no clear mental gallery of colours for purposes of identification.

Another factor in musical ability that occurs to me is the degree of complexity of sound of which a person can form an image. Some musicians are said to be able to hear mentally the playing of a whole orchestra. Many persons, probably, cannot hear distinctly a three-note chord. Very often, in these cases, what remains in their minds after the chord has died away is not really sound at all, but something vaguer: a sort of "emotional atmosphere." The precise nature of this "atmosphere" might be worth investigation, and also, perhaps, the kindred question of whether music in a minor key invariably tends to suggest sadder emotions than music in the major.

Possibly most of these points are really included under one head or another of Professor Seashore's method, but from Mr. Thouless's necessarily summarised account it is difficult to be sure.

Yours, etc.,

C. B. DAVY.

27 GROVE TERRACE,
CLAY PIT LANE,
LEEDS.
February 28, 1923.

WE regret that an error occurred (on page 72, col. 2, last sentence) in the publication of Mr. R. H. Thouless's article on the subject, which appeared in our March number. The reader will get the right meaning by substituting the word "pitch" for "time" in both cases where the latter word has been inserted in this sentence.

Miscellanea

RECENT DISCOVERIES OF ANCIENT HUMAN REMAINS

TWO interesting discoveries of ancient human remains were announced towards the end of the month of February. The *Daily Mail* of February 26th published a sensationally written report of the discovery of a well-preserved dolmen, or chamber of large upright stones with a flat stone cap, at St. Ouen, Jersey, in the course of excavations by workmen at the back of a house. With the dolmen was associated a kitchen midden, or refuse heap, full of limpet shells, a stone for grinding corn, and an ancient human skull. The skull was very much flattened, so much so that it was said to have no forehead at all, and on this account it was suggested that it belonged to a type very much older than that of *Pithecanthropus erectus*, the ape-man of Java, while the kitchen midden was thought to belong to the Mesolithic or Pre-Neolithic Age, presumably on account of its resemblance to the kitchen middens of the Baltic area which belong to this period. The discovery is interesting, but neither of these sensational suppositions is well founded. The flattened appearance of the skull, in all probability, is merely due to post-mortem flattening by pressure after burial, a thing which often happens in the case of prehistoric skulls, while the shell heaps are not necessarily very early in an island in which the limpet has always formed an important article of diet. The association with a dolmen suggests a Late Neolithic date.

A more interesting discovery is announced from Pata-

gonia. According to a Reuter's telegram from Buenos Aires, published in *The Times* of February 28th, Dr. Wolf, in the course of a two years' expedition to Patagonia on behalf of the La Plata Museum, has discovered a fossilised human skull of Tertiary Age. If investigation of the details of discovery and of the geological conditions in which it was found confirm the view that it belongs to the third great geological epoch into which pre-recent geological time is divided, and if an examination of the form of the skull shows that it is really of primitive type, it would mean that the oldest known human remains have been discovered in South America antedating by many thousands of years *Pithecanthropus erectus*, the earliest ancestor of man at present known, and the fossil tooth said to be human or sub-human in type and of Pliocene Age recently found in Nebraska. It is hardly necessary, however, to remind our readers that evidence for the existence of man in Tertiary times in South America, which has been brought forward up to the present, has not hitherto withstood criticism, as was shown recently in these columns.

THE PRESERVATION OF ANTIQUITIES

The public interest in antiquities, especially Egyptian, has recently been stirred by the discovery of King Tutankhamon's tomb. The accounts given in the daily Press of the operations at Luxor have stimulated curiosity and interest in a way that is reflected by the attendance at the British Museum; the collection of Egyptian and Assyrian antiquities in the Museum is now constantly thronged with visitors.

Many visitors will have noticed here and elsewhere in the Museum that a number of the specimens show unmistakable signs of decay; metals appear encrusted and corroded; wood, rotten and fragile; earthenware, cracked and broken. This all seems quite natural, but when he is drawn—as he inevitably is—to the Egyptian mummies, the visitor sees an arrestment of decay that is startling. Surely, if the human body can be preserved through thousands of years, means can be devised for preventing the deterioration of stone, metals, wood, etc. The corroded and decayed appearance of many museum objects arises from the fact that they were received in this state and that little or no attempt has been made to clean and restore them. Failure to do so is due partly to æsthetic and antiquarian reasons, and partly to lack of knowledge of suitable restorative processes, and partly to fear that irreparable damage to the precious objects may occur.

The embalmers of Egypt did not attain their object solely by the use of chemicals; before treatment the body was thoroughly and carefully cleaned. It is interesting to note that this is precisely the line of attack that is being adopted at the British Museum. For some time practical scientific investigations have been conducted in the Museum under the direction of Dr. Alexander Scott, F.R.S., with the object of discovering the causes that have led to the deterioration of specimens and of devising suitable methods for arresting the decay. In the majority of cases it has been found that mineral salts are responsible for the damage; these must be removed if permanent restoration is to be obtained. In other words, the specimen must first be thoroughly cleaned and then treated with preservative reagents.

Work of this nature obviously involves difficult and delicate operations. The use of an unsuitable method or chemical may destroy the specimen, spoil its appearance, or otherwise diminish its antiquarian value; both the knowledge of the chemist and the solicitude of the antiquarian are needed. A single example of the successes achieved will serve to show how true this is.

Some carved wooden figures, that had been lying for probably two thousand years under guano deposits, were brought to the laboratory in a very dilapidated condition; the wood was soft and spongy, and could scarcely be touched without causing damage. By analysis of a fragment the presence of harmful mineral salts, partly derived from the guano, was detected. But here a difficulty arose; when immersed in water, nearly half of the material of the fragment was removed; water, consequently, could not be used to wash out the salts from the images. Consideration of the nature of the material removed by water suggested, and experiment confirmed, that dilute acids could safely be used to remove the destructive salts and these alone. After this treatment the figures were still soft and spongy; some means of strengthening them had to be found, and in solving the problem the faculties of the chemist and antiquarian were employed to ensure that no harmful constituent was introduced and that their appearance was unchanged. The problem was solved; the deterioration of the wooden figures was arrested, and they can now be handled without danger.

These and other problems are discussed in a Report[1] that has just been published. It is impossible here to do more than indicate some of the results which are described in the pamphlet. Exhibits of metal, such as spear-heads and coins, that were brought to the laboratory corroded and apparently of no use for museum purposes, were restored to their original appearance. Earthenware, previously crumbling at an alarming rate, has been rendered quite sound. Paintings in which the high lights had blackened have been restored and, moreover, the treatment is such that there should be no recurrence of darkening. Varied and numerous objects of silver, lead, copper, and bronze which had been seriously corroded have all been successfully restored.

The appearance of this Report at the present time is most opportune, since the methods described can hardly fail to be applicable to some of the antiquarian treasures now being removed from the tomb at Luxor.

The Report should be of interest to many besides museum curators and art dealers; antiquarian, scientist, and private collector alike will find much that is helpful and suggestive in its pages. The text is illustrated by many excellent collotypes arranged to show in a clear way the value of the restorative processes which are described.

[1] *The Cleaning and Restoration of Museum Exhibits.* Second Report upon Investigations conducted at the British Museum. Published by H.M. Stationery Office, price 2*s.* net Copies are obtainable directly from H.M. Stationery Office, at the following addresses:—London: Imperial House, Kingsway, W.C.2; 28 Abingdon Street, S.W.1; Manchester: 37 Peter Street; Cardiff: 1 St. Andrew's Crescent; Edinburgh: 23 Forth Street; or through any bookseller. The post-free price is 2*s.* 1½*d.*